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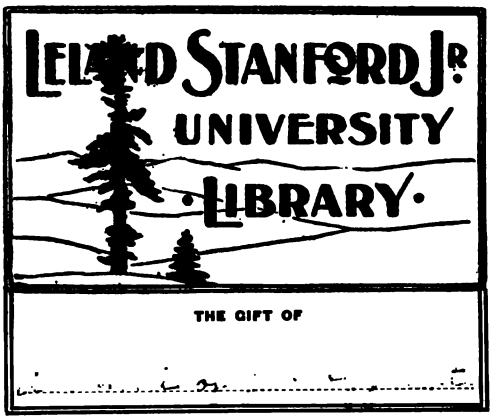
CONCHOLOGY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RECOMMENDATORY NOTICES.

OPINION OF SAMUEL GEORGE MORTON, M. D.,

Professor of Anatomy and Physiology, Pennsylvania Medical College.

To Messrs Turner & Fisher.

I have carefully examined the First Book of Natural History, embracing *Physiology and Animal Mechanism*, and have no hesitation in pronouncing it an admirable compend of the subjects of which it treats. The structure and function of the various organs are concisely and clearly expressed, and illustrated by appropriate diagrams. The work is the best I have seen for elementary instruction, and is especially adapted for the use of schools.

SAMUEL GEORGE MORTON.

Philadelphia, July 22d, 1841.

OPINION OF ROBLEY DUNGLISON, M. D.,

Professor of the Institutes of Medicine and Medical Jurisprudence in the Jefferson Medical College, Philadelphia.

It is now universally admitted, that a knowledge of the Animal Mechanism ought to form a part of common school education. Already, the subject has been introduced with great advantage into certain of our schools, and it is but necessary that works like the "First Book of Natural History" should be extensively disseminated, and have it introduced into all.

The First Book of Natural History has been prepared for the use of Schools and Colleges, by Dr. Ruschenberger, from the text of Milne Edwards and Achille Comte, Professors of Natural History in the Colleges of Henry IV, and Charlemagne. Emanating from such competent individuals, the work could not fail to be admirably adapted for the object in view, and as such the undersigned recommends it for general adoption.

ROBLEY DUNGLISON.

To Dr. Ruschenberger.

July 22d, 1841.

OPINION OF J. CARSON, M. D.,

Professor of Materia Medica in the Philadelphia College of Pharmacy.

Philadelphia, July 28th, 1841.

Dear Dr.,—I have been highly gratified with the examination of your "*First Book of Natural History.*" It appears well adapted to accomplish the purpose for which it is designed by you. The original text, from which the main body of the work has been formed, needs no further recommendation than the statement made in the title-page, that it is derived from Milne Edwards and Achille Comte, writers who deservedly stand foremost in the rank of living naturalists and physiologists. Your own additions, especially the system of interrogatories, will be found greatly to facilitate the labour of teaching. In presenting a work upon the subject, to the public, in so small a compass and at so moderate an expense, I am sure that you have aided materially in the cause of education. Be pleased to accept my best wishes for the success of your undertaking, and believe me to be,

Sincerely yours,

J. CARSON.

To W. S. W. Ruschenberger, M. D., &c.

RECOMMENDATORY NOTICES.

OPINION OF JOHN TYLER,

President of the United States.

{ President's House,
{ February, 4th. 1842.

The President takes pleasure in acknowledging the receipt of the work on Physiology, which Messrs. Turner & Fisher had the kindness to send. From the slight examination he has given it, he regards its arrangement as good, and believes the whole work well adapted to the object for which it is intended.

MESSRS. TURNER & FISHER, *Philadelphia.*

OPINION OF JOHN T. SHOTWELL, M. D.

Professor in the Ohio Medical College.

{ Medical College of Ohio,
{ Oct. 24th. 1842.

It gives me pleasure to acknowledge the receipt of the First and Fourth Books of your Series, of Natural History, by Dr. Ruschenberger.

I have examined them, and believe they possess higher merit than any Class Books of Natural History that have yet appeared in our country.

The *elements* which are so important in the acquisition of any science, are presented in a form so captivating, and so well adapted to the instruction of youth, as must insure their adoption, as First Books in Natural History, in all our Schools and Colleges.

Wishing you success in your laudable enterprise, I am

Very respectfully yours, &c.

JOHN T. SHOTWELL.

To MESSRS. TURNER & FISHER.

NATURAL HISTORY.—Two French professors of rare merit, M.M. Milne Edwards and Achille Comte, have published a complete Series of elementary treatises on the different branches of Natural History; and these treatises have been adopted for teaching this science throughout France. A distinguished physician, Doctor Ruschenberger, a Surgeon in the Navy of the United States, conceived the happy idea of translating and adapting them to the study in this country; it is a valuable addition to the means of teaching; for these treatises are remarkable for clearness of classification and distinctness of compilation; they should be adopted here as they have been in France in the original, and as they doubtlessly have been in the North. These little books, which with all their other merits combine that of low price, are published by Messrs. Turner & Fisher; we have received them through Messrs. Norman, Steel & Co. of this city, who have the exclusive sale of them.—*L'Abeille de Nouvelle Orleans. Nov.* 5, 1842.

"NATURAL HISTORY.—REPTILES AND FISHES: *by W. S. W. Ruschenberger, M. D. Turner & Fisher.*—This s the Fourth Book of this excellent series of publications, prepared for the use of Schools and Colleges. We have perused all of them with profit and pleasure, and can cordially recommend them as initiatory studies into the first principles of the science of which they treat."—*The Ladies Companion and Monthly Magazine, New York. Wm. N. Snowden. Nov.* 1, 1842.

OPINION OF THE PUBLIC PRESS.

"Such a little treatise is just the thing for our schools and academies and no time should be lost in introducing it."—*New York Mirror.*

"This is a most excellent work, and we would most respectfully recommend it to our common school trustees, as worthy of introduction into the temples of learning under their supervision."—*New York New Era.*

"The plan and arrangement of the work are admirable, and eminently calculated to facilitate the progress of the pupil.—We recommend it to teachers and heads of families."—*Philadelphia Sat. Chronicle.*

"We know of no books better calculated to convey elementary instruction than these, and heartily recommend the two which have appeared."—*Brother Jonathan.*

"We cannot too earnestly recommend it to public attention."—*Cincinnati Enquirer.*

"Decidedly one of the best elementary works on the subject with which we have ever met."—*New York Lancet.*

"The information it contains is at once lucid, intelligible, and satisfactory; it forms an excellent text-book for classes in schools, and cannot fail to infuse into the young mind a knowledge and love of Natural History. It is concise and comprehensive, and must if adopted in seminaries of learning, be exceedingly useful in inculcating a correct knowledge of the elements of Zoology. The plan is excellent, and must be found eminently useful."—*Alexandria Gazette.*

"It is one of the most valuable works of the kind we have ever read.—Such are the books we like to see disseminated among the people."—*New Orleans American.*

"The reputation of the author is a guarantee that the work is a good one. On examination we find it to be so. It is an admirable compend of the subjects of which it treats:—we should think, indeed, that it would attract the attention of teachers, both from its cheapness, and the admirable manner in which it is arranged."—*Cincinnati Gazette.*

"*The Second Book:*—this number treats of all animals that in infancy feed on the milk of their mothers; from the human being down to the musquito-catching bat.—Like the "First Book," it is divided into questions and answers, and a glossary; and is illustrated by six plates. It is as cheap as dirt; and contains an abundance of useful information. There are thousands of persons in this country, and millions in Europe, who do not know that whales give milk."—*New York Era.*

"We do not know a more useful set than this promises to be:—and IS."—*New York Aurora.*

"We hesitate not to say that it is a valuable work, and fully entitled to the high encomiums bestowed upon it; taken as a whole the work may be justly regarded as invaluable to schools."—*New York Standard.*

"It is a most valuable work, and one which we believe has no superior in our seminaries,—we know of nothing equal to it. It is very flatteringly recommended by the most distinguished men in France and in the United States, and deserves it."—*New York Courier and Enquirer.*

Ruschenberger's Second-Book of Natural History.—"This is another of those useful volumes, which Dr. Ruschenberger is so beneficially in editing. His former volume has already been received into some of our public schools, and we hope both it and the present may find their way into all."—*American Medical Intelligencer.*

The present work, is in our opinion quite a desideratum, and abounds with information of the most useful and, at the same time, most necessary character, every parent should place it in the hands of his children, and no public instructor should neglect to give it a place in his academy.—*Philadelphia Spirit of the Times.*

RECOMMENDATORY NOTICES.

"*Ruschenberger's Series.*—These volumes are constructed upon a new and admirable plan, combining great simplicity of arrangement, with a perspicuity and sententiousness of style seldom found in works of this class; and which has elicited the highest encomiums of upwards of thirty of the leading professors of the country, whose opinions have again been endorsed by most of the public prints."—*U. States Adv.*

"The developement of the principles of classification, is among the very best we have ever seen. Science is here dressed in her own native simplicity and beauty, so that the philosopher may admire, while the child may acquire it.—*Medical Reporter.*

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"An excellent publication adapted to the youthful mind, and a great help to the more matured."—*Mercury.*

"The study of Natural History though generally neglected in schools, is of undoubted use: the present work contains a great amount of information within a small compass, and properly condenses it for the young mind."—*N. Y. Journal of Commerce.*

"*Ruschenberger's Series.*—The subjects are well treated, and from the exceeding cheapness, and admirable arrangement of these elementary works, they are well fitted for general use in public schools and academies."—*New York American.*

"We do not hesitate to say, that this is the best work of the kind and dimensions, that has even fallen under our notice. We hope all will embrace the first opportunity of procuring a copy, as we are sure they will prize it highly."—*Botanic Recorder.*

"A well digested and carefully arranged abstract of the most interesting parts of Natural Science."—*Philadelphia Gazette*

"Admirably adapted to convey an elementary knowledge on the subject of which it treats; and will be found an excellent book for the student."—*Public Ledger.*

"Valuable in every respect,—it contains a vast amount of information, condensed into an available form, for the use of schools."—*Spirit of the Times.*

"Just such a work as is wanted for elementary instruction, in this pleasing branch of science."—*New York Evening Post.*

"We regard this series as eminently useful, supplying adequately the instruction in natural history necessary to a proper school education."—*North American.*

"It is an excellent little work for the purpose designed, written in a clear and familiar style, and will not fail to facilitate the studies of those who wish to make themselves acquainted with the subject."—*Saturday Courier.*

"Admirably adapted for elementary instruction."—*Saturday Chronicle.*

"We have great pleasure in recommending it as an excellent elementary manual on the subject."—*Medical Examiner.*

"*Ornithology*—This book is equal in merit to the first and second, and is a most valuable work. It is intended for the use of schools and academies, and we would call the attention of parents and others to the series of books to which this belongs, assuring them at the same time, that it will answer the purpose for which it is intended, better than any other work of the kind that we ever saw, or, in our opinion, that was ever published in this country. It is divided into questions and answers, contains an extensive and valuable Glossary, and is illustrated by eight Plates; and what is more, the price is so very low that every person can afford to purchase it.—*New York New Era.*

RECOMMENDATORY NOTICES.

ORNITHOLOGY.—This is No 3, and like its predecessors is excellent. These are the most valuable additions of the day to our stock of School-Books. The avidity with which they have been seized upon is unprecedented. Though the first vol. was published for the first time only a few months ago, it has already gone into the fifth edition; the second is following close upon its heels; and the third promises to be even more popular than either of the other two. These books have been adopted by the "Royal Council of Public Instruction" for the use of Schools throughout France. They are recommended and have been adopted by some of the most eminent teachers in the United States.—*Southern Lit. Mes. July* 1842.

The present book conveys a large amount of useful and pleasing information on Ornithology. The structure, functions, and habits of Birds, are classified and grouped in such a manner as to gratify the student of Natural History, and at the same time to aid the tyro in remembering the peculiarities of individual birds, and their various points of resemblances to others of their family.—*Bulletin of Medical Science.*

The Third Book of Natural History is worthy of being placed alongside the first and second. Of these we have already spoken; and we may now, we presume, congratulate Dr. Ruschenberger and the publishers, that sufficient encouragement has been received to induce them to continue their interesting and instructive series.—*American Medical Intelligencer.*

The series of books of which this forms a part has been highly and justly commended by the ablest judges, as furnishing rare facilities in the acquisition of branches of knowledge, but too much neglected in our schools. We have examined the volumes with much care, and we find them well deserving all the praise bestowed on them.—*Gody's Lady's Book.*

DR. RUSCHENBERGER'S series of books on Natural History are among the most valuable and useful works for the use of schools that have ever been published. The text is that of two distinguished French Naturlists, Milne Edwards and Achille Comte—translated and prepared for the use of schools and colleges by Dr. Ruschenberger, who deserves great credit for thus devoting his leisure to so useful an object. A knowledge of Natural History is not only valuable, but deeply interesting, and no one's education can, with such facilities as are now offered, be considered complete without it. Simple and comprehensive as the elements of this science have been made by the French professors and Dr. R., and adopted as they should be, in schools and colleges, it would be inexcusable in any youth to be ignorant of these elements, and having acquired them he will find it equally easy and pleasant to enlarge his knowledge by consulting more extended works, and devoting his attention to the study of the various branches of this interesting science. The present book on Ornithology is upon the same plan and possesses the same merit as those that have preceded it, and which have been received with deserved commendation. It is brief and comprehensive, but sufficiently full to give the student a thorough knowledge of the elements of Ornithology. It contains also a Glossary of the terms used in this branch of Natural History, and a number of wood cuts illustrative of the matter contained in the body of the work.—*Washington National Intelligencer*

Precisely the work to place in the hands of young people.—*Madisonian.*

"We have much pleasure in commending this series of works—the third of which now before us, is on Ornithology. It will be found useful in the school-room, or the private study."—*U. S Gazette.*

RECOMMENDATORY NOTICES.

"Ruschenberger's Series of Books on Natural History, are among the most valuable and useful works, for the use of Schools that have ever been published. A knowledge of Natural History, is not only valuable, but deeply interesting; and no one's education can, with such facilities as these works afford, be considered complete without it."—*National Intelligencer.*

"These are the most valuable additions of the day to our stock of School Books. The avidity with which they have been seized upon is unprecedented. Though the first vol. was published for the first time only a few months ago, it has already gone through its fifth edition; the second is following close upon its heels; and the third promises even to be more popular than either of the other two. These books have been adopted by the 'Royal Council of Public Instruction,' for the use of Schools throughout France. They are recommended and have been adopted by some of the most eminent teachers in the United States."—*Southern Literary Messenger.*

From "The Ladies' Companion, a Monthly Magazine." June, 1842.—New York. W. Snowden, 109, Fulton Street.

"RUSCHENBERGER'S ORNITHOLOGY: Turner & Fisher. This is an excellent book, by one who shows himself perfectly qualified for the task he has undertaken, which is the publishing of a series of works on the different branches of education, for the use of schools and colleges. The present issue is a general and synoptical view of Ornithology, one of the most interesting subjects in Natural History, and will be found of great service, both to teacher and student."

"This is a compendious, and, as it seems to us, a judiciously compiled treatise on Ornithology, and one well calculated for the use of Schools; for which object it is intended."—*N. Y. Courier and Enquirer.*

"In the work before us, the plan is happily carried out. In its small compass it embraces an immense amount of useful and interesting information."—*Buffalo Adv. and Journal.*

"*Ornithology.*—This is evidently, like its predecessors, an excellent work of instruction; and has been, in all respects well got up by the publishers."—*Pennsylvanian.*

"A valuable little work, and is divided up and classified admirably. The glossary, giving the derivation of the names of birds, is of itself worth the price of the volume."—*New York Aurora.*

"An exceedingly interesting, and very instructive book, and one which possesses special attraction for young ladies."—*Baltimore Sun.*

"RUSCHENBERGER'S SERIES: *Second Book.*—A highly useful and instructive school book. *Third Book.*—This we consider as decidedly an acquisition to our list of school books, the subject is treated of in such a plain style as to be adapted to the simplest capacity. Altogether we think the above series as worthy to take a high and permanent place among our school books."—*Buffalo Democrat.*

"We wish we could induce our teachers generally to examine this, as well as the earlier works of Dr. Ruschenberger; they are admirably arranged, and just the very books needed for schools. The work before us on the Natural History of Birds is an admirable one, and no teacher should neglect to introduce the series."—*Cincinnati Gazette.*

"It is an excellent text-book of an interesting science, comprising much knowledge in a brief space, presented in a clear style and with lucid arrangement. Dr. Ruschenberger, who has already achieved a high character in the literary world, is acquiring additional claims by his exertions in the field of Natural Science.—*Spectator, Washington City.*

RECOMMENDATORY NOTICES.

It is sufficient to say for it that the original is used in France by order of the Minister of Public Instruction. Dr. Ruschenberger, the accomplished translator, has added original notes and questions upon the text, which are a great improvement upon the French plan. The propriety of making physiology and the kindred branches of science subjects of study in primary schools, is too apparent to require enforcement. Dr. Ruschenberger has well applied his knowledge and taste in this volume, and we hope that he will follow it by others explanatory of the sciences which pertain to his professional studies.—*Philad. Nat. Gaz.*

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We commend the work to the attention of those concerned, as admirably adapted to the use of schools. The correctness of the descriptions, and of the plates illustrative of the text, is vouched for by the most scientific of our city.—*U. S. Gazette.*

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From a hasty glance at the work, the recommendation of a number of distinguished professional men, and the eminent character of its author, we have no doubt it will prove a valuable acquisition in schools and colleges.—*American Sentinel.*

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The plates are correctly drawn, and will serve as a useful auxiliary to the young student in this branch of education.—*Boston Traveller.*

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The style is plain and comprehensive. Such a work is much needed among the text books of our schools and colleges,—none, male or female, should be without it. We heartily recommend it to the notice of teachers and pupils; for it is one of the most valuable acquisitions of the day to the catalogue of school books.—*Southern Lit. Mes.*

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The work is one of merit, and will find speedy and permanent success. The subject of which it treats is one of great importance, and one on which we are surprised to find such general ignorance existing.—*Sat. Eve. Post.*

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It has too frequently been an error with the authors of scientific works designed for beginners, to degrade their style to the assumed intellectual inferiority of their readers. In the fear of not being understood, they omit proper scientific names in preference to those in common usage which but, partially convey the intended meaning, and that in the most vague and general manner. This we are convinced is altogether wrong; for independent of the limited ideas necessarily incident to such a style, the other when adopted, can be mastered more readily than the casual observer would at first suppose, and with the aid of a glossary, all difficulty at once vanishes. The work under notice is a clear instance of the correctness of our position. Although strictly elementary in its design, it never yields its scientific claims to the pretensions of popular phraseology. But to obviate any difficulty that might arise, an admirable glossary is affixed. This with the accurate plates referred to by numbers in the text, not only renders its comprehension easy, but its study agreeable. Independent of the abstract merits of the work, it supplies a place in the young scholar's library, which has long been vacant. While almost every department of knowledge has been made more plain, and pleasant by a multiplication of books and charts, each succeeding one improving on its predecessor—this we believe is the first of its kind offered by an American publisher to teach "the proper study of mankind."

The "First Book of Natural History" will very soon find a place in all our seminaries of learning. The general reader, likewise, who may wish to inform himself of the circulation of the blood, of respiration, digestion, the nervous system, &c., may, by means of this work, save himself much laborious research in professional treatises.—*Del. State Journal.*

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We have rarely perused a school book containing so much valuable information in so small a compass, and so admirably arranged as well as peculiarly suited to the quick comprehension of learners. Indeed, there is in the book a store of information for many who have not had, and may never have, the leisure to search the source from which it is derived. The work is highly recommended by scientific, literary, and particularly medical men, and we concur in their opinion of its value, and of its usefulness as a standard book for schools.—*N. Y. Standard.*

—

This work is sent forth to the public with the strongest recommendations, and we doubt not it will have, as it deserves, a most extensive circulation.—*N. Y. Times and Evening Star.*

—

This work is one of great merit, and the author has shown himself well-versed in the important and deeply interesting science of which he has so ably treated.—*N. York Planet.*

RECOMMENDATORY NOTICES.

It has been justly observed, that "the double effect of the study of Natural History is to impart certainty to the mind, and religion to the heart," and the christian no less than the man of science, must rejoice in every effort to throw more widely open the sublime and boundless field which it presents. This is the design of Dr. Ruschenberger, in a series of First Books of Natural History, which he is preparing for the use of schools and colleges.—*Banner of the Cross.*

The series have met a demand and sale in France almost unparalleled, and the words are well adapted, not only for schools, but for popular reading and instruction. This work is from the French of Edwards and Comte, and has received the warm commendation of many of the best physicians and scholars in this country.—*N. Y. Eve. Tattler.*

It is highly commended by the very best authorities.—*N. Y. Tribune.*

This book is highly commended by competent judges, and we therefore give our solemn opinion that it is an excellent work.—*Boston Daily Times.*

A small, but very valuable work.—*Boston Evening Transcript.*

We have examined this new book for schools and colleges, with peculiar gratification. The style is succinct and clear, and the subject illustrated by appropriate drawings. We should be glad to see this work introduced into all the schools. It teaches knowledge the most important, which has been, however, strangely overlooked in our school and college system. It is a book which should not be confined to seminaries alone. It may be used with advantage by all individuals in society. We repeat, it is in all respects a most excellent work, and we hope will receive the attention and patronage it merits.—*Brooklyn Evening Star.*

A valuable work; we have read it with profit.—*N. Y. Mercury.*

We are highly pleased with this work. For elementary instruction in families, schools, and colleges, it is decidedly superior to any thing of the kind we have seen. It gives much valuable information in a very small space, and in style it is generally free from obstruse technicalities It has already received the highest recommendations from a large number of professional men in different parts of the country; and it must have, we think, a general circulation. It gives that kind of knowledge which should be diffused among the mass of the people, and it must and will be patronised as far as its merits are known.—*Zion's Watchman.*

This is a fine little book, containing the elements of much useful learning, illustrated by anatomical plates of the human figure, its organs and their functions. It is a highly useful work to the student—indeed to every citizen it shows how fearfully and wonderfully we are made, and what slight causes may derange and utterly destroy the complicated machine.—*The Olive Branch.*

A very useful little work.—*N. Y. Atlas.*

As far as we are competent to determine, it may safely be welcomed as an important addition to the means of elementary instruction in natural science.—*The Friend.*

We recommend it as a highly instructive publication.—*N. Y. Times and Eve. Star.*

This is a most valuable work, by Dr. Ruschenberger, and most admirably are the plates, representing all the different parts of the body, done. It is cheap, and every parent should place one in the hands of their children.—*N. Y. Herald.*

We have examined this little volume with much pleasure, and think it admirably adapted to the purpose for which it is intended. Animal Mechanism, as a study, has generally been neglected, except by the few, whose profession requires a knowledge of it, and who have time to spare in acquiring that knowledge. A prominent cause of the neglect of this useful and interesting science by the general student, is, the want of a suitable treatise upon the subject, those extant being too voluminous, technical, and expensive for general use. The little work before us is happily calculated to supply this want. It will, we think, be introduced into our schools and colleges as a text-book, but its circulation ought not to be confined there. Every private library should be considered incomplete without it.—*N. Y. Mechanic.*

It seems to us to be well suited for the object for which it is designed, and it will doubtless be introduced into many of our elementary schools.—*The American Journal of the Medical Sciences.*

RUSCHENBERGER'S SERIES.

FIRST-BOOKS OF NATURAL HISTORY.

MOLLUSCA.

ELEMENTS OF CONCHOLOGY:

PREPARED FOR THE USE OF

SCHOOLS AND COLLEGES,

BY

W. S. W. RUSCHENBERGER, M. D.,

SURGEON IN THE U. S. NAVY; FELLOW OF THE COLLEGE OF PHYSICIANS;

HON. MEMBER OF THE PHILADELPHIA MEDICAL SOCIETY;

MEMBER OF THE ACADEMY OF NATURAL

SCIENCES OF PHILADELPHIA;

ETC., ETC.

FROM THE TEXT OF

MILNE EDWARDS, & ACHILLE COMTE.

PROFESSORS OF NATURAL HISTORY IN THE COLLEGES OF

HENRI IV, AND CHARLEMAGNE.

WITH PLATES.

FIRST THOUSAND.

TURNER & FISHER:

PUBLISHERS:

15 NORTH SIXTH STREET, PHILADELPHIA;

169 BROADWAY, NEW YORK.

1843.

ENTERED, According to an Act of Congress, in the year 1843, by W. S. W. Ruschenberger, M. D. in the Clerk's Office, of the District Court of the United States, in and for the Eastern District of Pennsylvania.

234559

PREFACE.

The fifth of the Series of First Books of Natural History, embraces that branch of our subject, which treats of the Mollusca, or soft animals, and consequently, includes the Elements of Conchology.

In the beauty and singularity of their forms, the variety and brilliancy of their colours, shells only yield to flowers. The admiration of these deserted habitations of a very numerous class of animals is very general, if not universal; scarcely a house, at least in sea-port towns, is without a few shells, and in many there are large collections of them. Comparatively, few persons, however, view them in connection with animal existence —for the mass, they are merely beautiful things from the seas and rivers far and near. We care little how they grow, how they live, how they breathe, upon what they feed, or for what use they were created. Who stops to think an oyster has a heart and blood vessels, a breathing apparatus, a nervous system, or digestive organs? How very few are aware that certain snails possess eyes and lay eggs; nor is it universally known that we are indebted to the organization of soft animals for mother of pearl and pearls.

Limited as this little volume is, it may prove a key to stores of information, even more interesting to many than the numerous fictions of the day. "Truth is stranger than fiction," has been often said, and the beautiful truths brought to us by a study of animal life, in its various forms, are certainly more admirable and wonderful than any fiction of man's creation.

Is there any thing produced by the Bulwers or the James' of the day, more worthy of admiration than the habits of a snail, or the movements of a cockle-shell? When at the Sandwich Islands in 1836, we heard an anecdote which has an application here. The officers of a British ship of war manifested a strong desire to obtain "curiosities:" a young Kanaka, with a view to profit, brought to one of these officers, a chicken's foot, and offered it for sale, and by way of insisting upon its value, said, as he pulled the tendon which was attached to the toes, "See how nicely it works;" and was it not more worthy of attention and thought than all the fictitious idols of wood and stone that could be collected?

Fictions are the work of man, but the wonderful truths of the universe are the creations of Omnipotence, and yet we bestow more time, and more interest on the last novel, in many instances, than would be sufficient to lead us to the contemplation of all the beautiful and magnificent productions which it was Adam's duty to name. Whoever reveres his God, should be able to contemplate his works understandingly, and be able to perceive the beauty of design, the adapttaion of the organization, the various forms of life, to the circumstances in which life is placed, and perceive the same wise hand in the structure of the snail, as in the complete and perfect animal, man; and learn too, that even an oyster is within the scheme and protection of Providence.

In forming this little volume, besides the works of MM. Edwards and Comte, those of Cuvier, Lamarck, Blainville and Captain Thomas Brown, have been consulted, and freely used.

Many of the engravings are copied from the works of M. Blainville; and, it is believed, the engraving, which was done by Mr. G. Thomas, (No. 37 South Third Street,) will compare favourably with any thing of the kind ever offered to the American public.

The etymology and pronounciation of the technical words have been placed at the foot of the page.

This little volume offers the means of becoming acquainted with the history of soft animals and Conchology, and opens the way to an advantageous perusal of more complete and ample treatises on the subject.

Philadelphia, March, 1, 1843.
No. 132 *Spruce Street.*

LIBRARY

HENRY HEMPHILL.

CONCHOLOGY.

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ELEMENTS OF CONCHOLOGY.

SECOND BRANCH OF THE ANIMAL KINGDOM.

MOLLUSCA:

MOLLUSKS, OR SOFT ANIMALS.

LESSON I.

GENERAL CONSIDERATIONS.—*Mollusca in general—Organization—Nervous System—General Form—Skin—Mantle—Shell—Formation of Shell—Digestive Apparatus—Circulation of the Blood—Respiration—Senses—Eggs—Classification.*

The long series of vertebrate animals, the history of which we have already concluded, forms only a small part of the animal kingdom, and to make the beings we are now about to study as interesting as the vertebrata, we should be obliged to very far exceed the limits of these lessons: but these animals are less useful to us; they attract less attention, and most of them pass unnoticed, except by those who are at the pains of becoming acquainted with them; their faculties are more limited and their structure is less complicated and less perfect.

1. All these lower animals want a spinal marrow and a true internal skeleton; this last character has obtained for them the collective name of *invertebrate animals*; but in a natural classification, they could not all be placed in the same group, because they are evidently formed after three different types, and therefore should be divided into three distinct branches, namely: the *mollusca*, the *articulata*, the *radiata*, or zoophytes.

2. The branch of zoophytes is composed essentially of the most imperfect animals, and comprises in the classification of Cuvier, which we follow, a certain number of beings which seem, in a manner, to present the first sketch of the mode of organization proper to mollusks and articulate animals; its place is therefore among the lowest grades of the animal series and passes by gradual shades from the type of the radiate animal to that of the two great branches which spring from it. These two latter branches, one equally with the other, present a constantly increasing complication of organization, and form, as it were,

1. What are inver'tebrate animals? What groups or divisions include the inver'tebrate animals?

2. What are zo'ophytes? Why are the mollus'ca placed before the articulata in the series of animals?

two parallel series. The series of articulate animals seems to be the highest in the scale; but the mollusca, though less perfect in structure seem to be less remote in their mode of organization from the vertebrata, and for this reason we have determined to place them first.

3. We give the name of *Mollusca* (from the Latin, *mollis*, soft,) to animals, which, in the general features of their organization, resemble snails, oysters &c. They have no articulated skeleton nor vertebral canal, like the vertebrate animals; their body is soft, and their skin, which is often covered by a shell, is never hardened so as to form a kind of external skeleton composed of a series of rings, as is the case in insects and the crustacea.

4. The nervous system, an apparatus of so much importance, the action of which regulates all the phenomena of animal life, and the functions of which must necessarily be in harmony with its mode of conformation, differs altogether in the mollusca, in its general disposition, from what we observe in the vertebrata. There exists a nervous centre which to a certain extent may be compared to the brain in superior animals; but this ganglionic mass is not continuous with an organ analogous to the spinal marrow; the other central parts of the nervous system are found on the opposite side of the digestive tube, and hence this canal is always embraced by a sort of medullary collar, from which the different nerves of the body arise. In other respects, this apparatus varies more in its arrangement than in the number of parts composing it.

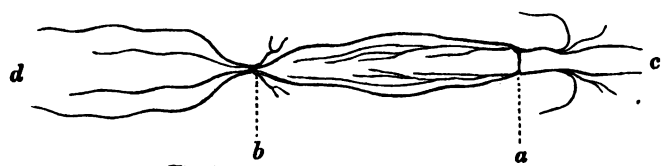

Fig. 1.—NERVOUS SYSTEM OF A SOLEN.

5. In a great many of the least perfect mollusks, such as the Solen and many other acephala, which inhabit bivalve shells, the nervous system is generally composed of but two pairs of ganglia, united by two long inter-ganglionic cords, giving rise to different branches (*fig.* 1); the ganglia of the anterior pair

Explanation of Fig. 1.—Nervous system of an acephalous mollusk (Solen):—*a*, the pair of ganglia which is situate in front of the œsophagus representing that portion of the nervous system of these animals, which is

3. What are the general characters of the Mollusca?
4. What are the peculiarities of arrangement of the nerves of the Mollusca?
5. What are the general characters of the nervous system in acephalous mollusks? What are the peculiarities of the nervous system of gasteropods?

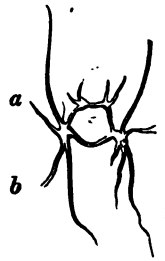

Fig. 2.
NERVES OF A JANTHINA.

(*a*) are sometimes considerably separated from each other and only united by an intermediate cord, and sometimes glued one to the other, or even confounded in a single mass: they are situate above the œsophagus and far from the posterior ganglia (*b*), which are placed beneath the intestine towards the posterior part of the body. In some mollusks, the nervous system is still more simple in its composition; but, in general, the ganglia tend to approximate the œsophagus more and more (*fig.* 2), and in most of these animals we find a greater number of small medullary masses, some of which form a sort of nervous centre, and the others are distributed in different parts of the body. Thus, in the snails and most mollusks constructed on the same plan, and named *gasteropods*, (from the Greek, *gaster*, belly, and *pous*, foot,) on account of their mode of crawling on the ventral surface of the body, there exists above and in front of the œsophagus a medullary mass, (*fig.* 3. *c.*), which is the representative of the anterior pair of ganglia above mentioned, and which is regarded by most anatomists as the

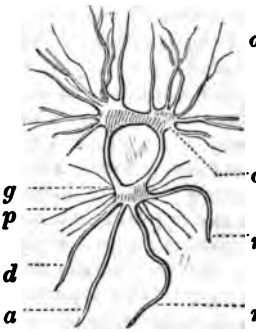

Fig. 3.—NERVES OF A SNAIL.

generally called the brain; here, these two ganglia are considerably separated from each other, and are united by a transverse band;—*c.* nerves which arise anteriorly to be distributed to the tentacula, to the mantle, &c.;—*b.* ventral pair of ganglia, which are united in a single mass, placed beneath the intestine, and joined to the anterior ganglia by two very long nervous cords;—*d.* nerves which arise from the posterior ganglia to be distributed to the mantle, &c.

Explanation of Fig. 2.—Nervous system of a Janthina; a gasteropod mollusk, in which the posterior ganglia (*b*) as well as the anterior ganglia (*a*) are separated from each other; but they are more approximated to the latter, so that the inter-ganglionic cords are very short, and form a sort of closely fitting collar around the œsophagus.

Explanation of Fig. 3.—Central portion of the nervous system of the snail:—*c.* ganglia situate in front of the œsophagus, and constituting, by their union, the mass which is called the brain in mollusca;—*o.* nerves of the anterior parts of the body, the eyes, &c.;—*g.* the nervous mass formed by the union of the ganglia of the posterior pair; the œsophagus passes through the collar or ring which unites it to the brain;—*p* the nerves of the foot;—*n.* nerves which go to the pulmonary cavity, &c.;—*a.* the nerve which accompanies the principal artery;—*d.* the nerve which goes to the diaphragm, &c.

brain of these animals: it furnishes nerves to the organs of the senses as well as to the neighbouring parts (*o*), and is continued posteriorly by two inter-ganglionic cords which embrace the œsophagus, and which at a short distance, unite with a second nervous mass (*g*), situate beneath the digestive tube and comparable to the posterior pair of ganglia, which we remarked when speaking of the acephalous mollusks; and two small nerves, which arise from the brain, unite to form a third ganglion (*fig.* 4 *t.*) below the origin of the œsophagus. In other gasteropods, the *aplysiæ* or sea hares, for example, to these ganglia is joined another (*fig.* 4 *v.*) situated among the viscera, and united by two communicating threads to the medullary collar which surrounds the œsophagus, and giving rise to the nerves of the intestines, liver, branchiæ, ovaries, &c. We also find in these mollusks a fifth ganglion, which is very small, belonging to these latter organs. And, in the *poulpes* and the cuttle fish (*fig.* 5.) in which this system acquires its highest degree of developement, the ganglionic parts grouped around the œsophagus, are larger and more complicated; for the cephalic and post-œsophageal ganglia united in a large œsophageal collar, present

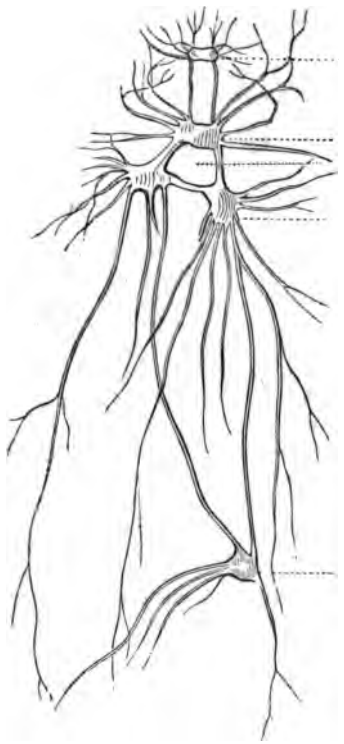

Fig. 4.—NERVES OF THE APLYSIA.

Explanation of Fig. 4.—Nervous system of the aplysia, (or sea hare, as it was called by the ancients,) another gasteropod mollusk;—*c.* the brain;—*o.* the nervous collar which surrounds the œsophagus;—*g.* the thoracic or post-œsophageal ganglia;—*v.* the visceral ganglion;—*t.* the buccal ganglion.

laterally a third pair of ganglionic swellings, which are lodged in a cartilaginous, cranial cavity; from them arise the nerves of the feet, (*Fig.* 5.)

To recapitulate, we see that, in this class of animals, the nervous system is essentially composed of a medullary collar, embracing the alimentary tube, and formed by the communicating cords of the two pairs of ganglia, which are widely separated in the acephalous mollusks, but approximate more and more as we ascend in the series, formed by the gasteropods and cephalopods; and the

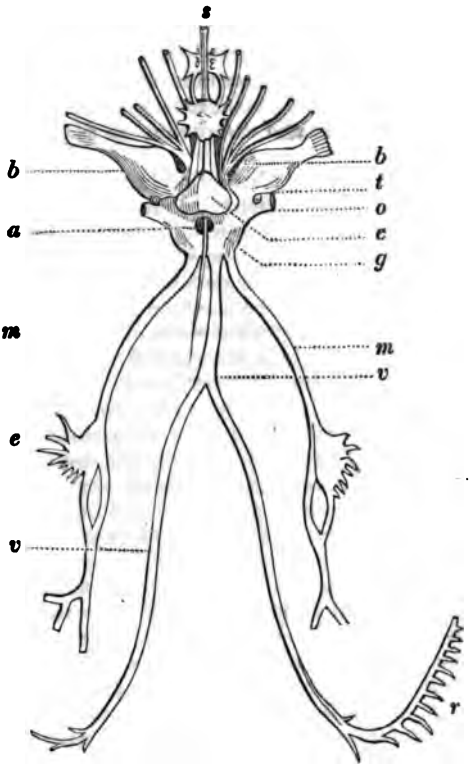

Fig. 5.—NERVOUS SYSTEM OF THE CUTTLE-FISH.

Explanation of Fig. 5.—Nervous system of the Cuttle-fish :—*a*. the nervous collar which embraces the œsophagus, the course of which is indicated by a bristle (*s*) ;—*c*. the nervous mass, situate in front of the œsophagus, and commonly called the brain: the upper surface is surmounted by a very large cordiform tubercle, and from its anterior part arise two nerves that soon terminate in a circular ganglion, which, in its turn, gives rise to another pair of nerves which descend beneath the mouth so as to embrace the œsophagus again, and then form a small anterior ganglion from which arise the labial nerves ;—*b*. the tentacular ganglia, from which arise the nerves of the arm;—*o*. the optic nerves which arise from the lateral parts of the brain, and soon swell into a large ganglion ;—*t*. small nervous tubercles, situate on the origin of the optic nerves ;—*g*. the sub-œsophageal or ventral ganglion ;—*v*. the great nerve of the viscera, one branch of which presents an elongated ganglion (*r*,) and penetrates into the branchiæ ;—*m*. nerves which also arise from the post-œsophageal ganglia, and which, in their course, present a large star-like ganglion (*e*) the branches of which are distributed to the mantle.

nerves which arise from each of these ganglia, to be distributed to the different organs, are at first simple, but very soon present in different parts of the body ganglionic swellings; but these ganglia however numerous they may be, never form a regular longitudinal chain, extending along the middle line of the abdominal face of the body, as is the case in the articulated animals.

6. As we have already said, in this great branch of the animal kingdom, there is neither an internal skeleton, analogous to the solid frame of vertebrate animals, nor an external skeleton, similar to the tegumentary sheath, which envelopes the whole body of articulate animals in a series of rings and serves the same purposes as the skeleton properly so called, of the superior animals. The general form of mollusks is extremely variable. Their body is always soft, and in a very small number of them only, there exists internally some solid pieces which are unarticulated, and serve rather to protect the visceras than to furnish levers and points of support to the apparatus of locomotion. The muscles are attached directly to the integuments and act but very little beyond their point of insertion; their motions are slow, and in general ill directed. In a small number of these beings, there are elongated and flexible appendages, designed for locomotion (*fig. 7, page* 23); but in most instances the animal can change its place, only by successively contracting different points of the inferior surface of its body, and, even when it possesses extremities, they are united in a group at one end of the body, and never arranged in a symmetrical series as they are in vertebrate and articulate animals.

7. The skin of mollusks, which is always soft and viscid, often forms folds that more or less completely envelope the body, and this disposition has caused the name of *mantle* to be given to that portion of integument which ordinarily furnishes these expansions. Frequently this mantle or *pallium* is almost entirely free and constitutes two large veils which conceal all the rest of the animal, or rather, these two laminæ or membranes unite together so as to form a kind of tube; but at other times, it consists only of a sort of dorsal disk, the edges of which alone are free or surround the body more exactly under the form of a sack.

8. In general this soft skin is protected by a sort of stony cuirass named *shell.* It is a secretion having some analogy to that of the

6. What kind of a skeleton have mollusks? What are the general characters of their body? How is locomotion effected in mollusks?

7. What is the mantle or pallium?

8. What is meant by shell? What is meant by *naked mollusks*? What are testacea?

epidermis which produces this envelope. The follicles, ordinarily lodged in the edges of the mantle, deposit upon its surface a semi-corneous matter, mixed with a greater or less proportion of carbonate of lime, which moulds itself upon the subjacent parts and solidifies. The lamina or layer, thus formed, thickens and grows by successive deposits of new matter. Its superficies is not stony, but in form of a kind of epidermis. Sometimes it preserves a horny consistence throughout its whole thickness. In general however, the proportion of carbonate of lime that it contains rapidly increases and imparts to it a stony hardness. The internal surface is often harder than the rest and possesses a particular structure which renders it vitreous or shining and nacreous. Sometimes the shell always remains enclosed in in the thickness of the skin; but, in general, it is external, and extends beyond the mantle, so as to afford the animal perfect protection. Those which are unprovided with shells, or only have an internal shell, are called *naked mollusks*, and those in which the shell is visible are included under the name of *conchifera* or sometimes *testacea*.

9. The manner in which the shell grows is easy to understand. If we examine the shell of an oyster, for example, we observe that it consists of a multitude of superposed laminæ, the separation of which may be effected by the assistance of heat. These laminæ are formed successivly by the mantle of the animal which they cover, and, consequently the most external one must be the oldest; and it is also the smallest, and each new lamina that is added, exceeds the lamina situate above, so that while the shell is augmenting in thickness it is also increasing in size. In general, the distinctness of the lamina is less marked, and often the new matter is deposited in such a manner, that its molecules exactly correspond to the molecules of the matter already consolidated, and thus gives to the whole a fibrous structure.

10. Shells are adorned with most diversified and most agreeably arranged colours, which often vary with their age. They are almost always entirely superficial, and seem to depend on a sort of a dyeing process performed by the skin of the animal, which is coloured in a manner corresponding with that of its envelope. The colouring matter seems to be deposited upon the shell at the time of its formation: and its brightness is in proportion to the newness of the latter. It is produced by the edge of the mantle. When a shell happens to be broken and the ani-

9, How does the shell grow?
10. How are the colours of shells produced?

mal succeeds in repairing the accident, the part newly formed is always white, if it has not been in contact with the edge of the mantle; but if it correspond to this edge, it then assumes the colour that the latter presents at the point touched. For example, when this edge is spotted, we find corresponding spots on the margin of the shell, and, in proportion as the latter is elongated, these spots become confounded with those previously formed, and produce lines perpendicular to crossing striæ, or they do not join the latter but remain isolated, according as the mantle remains unmoved, and preserves the same relation to the margins of the shell, or frequently changes its position according to the movements of the animal. Sometimes the secretion of the colouring matter varies with age; and accidental circumstances may also modify it. Light, for example, exerts a very remarkable influence on this phenomenon, for not only are shells that are most exposed to the action of this physical agent, ordinarily most brightly coloured, but, when a mollusk lives fixed to a rock, or in some spot hidden beneath a sponge, or other opaque body, the part of the shell thus placed in darkness is always dull, and paler than that which is exposed to the contact of the solar rays.

The duration of shells and the length of time the animals live which inhabit them are circumstances not yet determined. When exposed to the action of the air and the vicissitudes of temperature and moisture for some time, shells usually change their colours and gradually become white. The animal matter which enters into its composition is destroyed, and disappears little by little; the laminæ separate from each other, particularly under the alternate influence of heat and cold, and become finally reduced to a calcareous powder, which is washed away by currents of water.

11. All mollusks are provided with an alimentary canal which is more or less folded on itself and open at its two ends, either at the extreme points of the body, or at points more or less near to each other. There is always a voluminous liver, and we often find them furnished also with salivary glands and organs of mastication; but the intestines are never held in their place by the assistance of a mesentery.

12. The blood of these animals is cold and colourless or slightly bluish, and circulates in a very complicated vascular apparatus, composed of arteries and veins. A heart, formed of a ventricle (*v*)

11. What are the general characters of the digestive apparatus of mollusks?

12. What is the nature of the blood of mollusks? How is it circulated?

of one or two auricles (*o*) is found in the track of the arterial blood, and sends this liquid to all parts of the body, from which it returns to the organs of respiration. Sometimes we also find, at the base of the vessels which enter this latter apparatus, venous reservoirs, erroneously called *pulmonary hearts*; for, having nothing in their structure resembling muscle, they cannot set the blood in motion, and consequently do not merit this name. (*See fig.* 9, *Page* 25.)

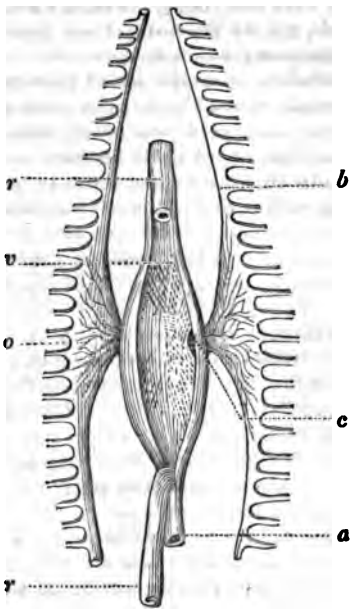

Fig. 6.—HEART OF AN ACEPHALOUS MOLLUSK.

13. The organs of respiration vary so much that they cannot be well described at this place: we will merely mention that they are sometimes in the form of lungs, and at others, in that of branchiæ or gills.

14. Nor can we say any thing generally of the structure of the organs of the senses, which are, however, always less complete than in the vertebrate animals. Certain mollusks appear to be endowed only with the sense of touch and with the sense of taste, but in a great many we find eyes which vary in structure, and in some of these animals there even exists an apparatus of hearing; but none is known to possess a particular organ of smell.

15. Mollusks are re-produced from eggs; but are sometimes hatched without, and sometimes within the body of the mother,

Explanation of Fig. 6.—Heart of an acephalous mollusk:—*v.* the ventricle, which, in these animals has the rectum, (*r.*) passing through it, and gives rise to two arteries, (*a*);—*c.* one of the auriculo-ventricular openings;—*o.* the two auricles receiving the blood from the branchial veins, (*b.*)

In the above diagram, the ventricle (*v*) is open, and the rectum, (*r,r,*) has been divided, and the lower part turned downwards:—*a.* at the lower part of the figure) represents the origin of one artery, the other artery having a similar origin above.

13. What is the character of the organs of respiration in mollusks?
14. What senses are possessed by mollusks?
15. How are mollusks re-produced?

and then the young are born alive. In all cases they possess at birth, nearly the form they preserve through life, and do not undergo metamorphosis.

We have already stated that mollusks differ very much in the general form of their body, and as these external modifications are accompanied by corresponding differences in the degree of complication of their internal organization, they enable us to divide these animals into six natural groups. The following table will give an idea of this classification.

BRANCH OF MOLLUSCA.

				(CLASSES.)
having a distinct head, and the body	in the form of an open sack in front, from which the head appears, surrounded by tentacula (*Fig.* 7. *Page* 23.)			CEPHALOPODA.
	not in the form of an open sack in front, and the head is not surrounded with tentacula.		membranous fins in the form of wings on the sides of the neck.	PTEROPODA.
	the principal organs of motion being		a fleshy foot occupying the ventral face of the body, and in form of a disk or sometimes of fins.	GASTEROPODA.
having no apparent head;	having four branchiæ distinct from the mantle, and almost always a fleshy foot			ACEPHALA.
	having no fleshy foot and seldom branchiæ distinct from the mantle.		provided with two ciliated arms which they have in place of them	BRACHIOPODA.
			unprovided with arms and special organs of motion.	TUNICATA.

Cuvier, and many other zoologists arrange the cirrhopoda also in the branch of mollusca; but it is now ascertained that these animals belong to the branch of articulata, the third great division of the animal kingdom.

16. Into how many classes is the branch of mollusca divided?

LESSON II.

CLASS OF CEPHALOPODA,—*General Form—Respiration.—Circulation.—Organs of Digestion.—Cephalic Cartilage.—Organs of Locomotion.—Organs of the Senses.—Nervous System.—Habits.—Division into two Families.*

FAMILY OF CEPHALOPODA DIBRANCHIATA.—*Octopus vulgaris, or Poulpe.—Argonaut.—Calmaries.—Cuttle-fishes.*

FAMILY OF CEPHALOPODA TETRABRANCHIATA.—*Nautilus.—Ammonites.—Belemnites.—Foraminafera.*

CLASS OF CEPHALOPODS.

1. This class is composed of Mollusks which are of fantastical shape, for their head is placed between the trunk and feet, or tentacula, which serve them for locomotion, and when they walk, the body is uppermost, and the head down, dragging on the ground. Their feet are attached, around the mouth, to the head, which circumstance has obtained for them the name of *Cephalopods*, (from the Greek, *kephale*, head, and *pous*, foot, —pronounced *kef-a-lo-pod.*)

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Fig. 7.—OCTOPUS* VULGARIS,—OR COMMON POULPE.

2. The trunk of these animals is covered by the mantle, which is in the form of a sack, sometimes almost spherical, and sometimes more or less elongated; it encloses all the

*From the Greek, *okto*, eight, and *pous* foot,—eight feet.

1. What kind of animals compose the class of Cephalopods? Why are they called Cephalopods?

2. What are the general form and characters of the Cephalopoda?

viscera and is open only in front, (*fig.* 8. *o.*) The head issues from this opening: it is round and generally provided with two round eyes, very analogous in their structure to those of vertebrate animals. The mouth occupies the centre: it is armed with two jaws; and around this opening is found a crown of flexible and fleshy appendages, which are termed indifferently, legs or arms, because they seem to be entitled to either appellation; for they serve both as organs of prehension and locomotion.

3. The cephalopods are essentially aquatic animals, and consequently they breathe by means of branchiæ. These organs are always perfectly symmetrical, and are found concealed beneath the mantle, in a particular cavity, (*fig.* 8.) the parietes of which alternately contract and dilate, and the interior communicates externally by two openings; one (*o.*) in form of a slit, serving for the entrance of the water, and the other prolonged in the shape of a tube or funnel, (*t.*) serving for the escape of water and excrement. Each branchia, (*b.*) which is in form of an elongated pyramid, the summit of which is directed forward, is composed of a great number of membranous lamellæ or leaves, placed transversely and fixed on each side of a middle stalk. Each one of these leaves is divided into lamellæ, which are in turn again sub-divided, and it is in their substance that we find the capillary vessels where

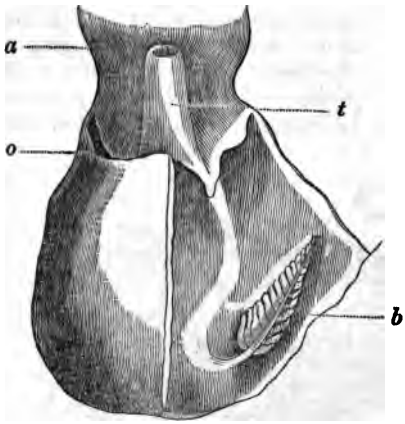

Fig. 8.—BODY OF A POULPE.

Explanation of Fig. 8.—The body of a Poulpe seen from beneath; (the mantle is slit up on the middle line, and, on one side, raised up to show the interior of the respiratory cavity):—*a.* the base of the head;—*t.* the tube by which the water escapes from the respiratory cavity;—*o.* one of the two lateral openings through which the water enters this cavity;—*b.* one of the branchiæ or gills.

3. How do Cephalopods breathe? How many branchiæ have Cephalopods?

the venous is changed into arterial blood. The number of branchiæ varies, and this difference is characteristic of the two great natural divisions, of which this class is composed. In some there is but a single pair, while in others two pairs of branchiæ are found. For this reason the first have been called *cephalapoda dibranchiata*, (from the Greek *dis*, two, and *bragchos*, branchia or gills,—*two-gilled*,) and the last, *cephalopoda tetrabranchiata*, (from the Greek, *tetras*, four, and *bragchos*, branchia,—*four-gilled*.)

4. The heart is situated between the branchiæ on the middle line of the body, and consists only of a single ventricle, (*fig.* 9. c.): the blood reaches it from the branchiæ by the

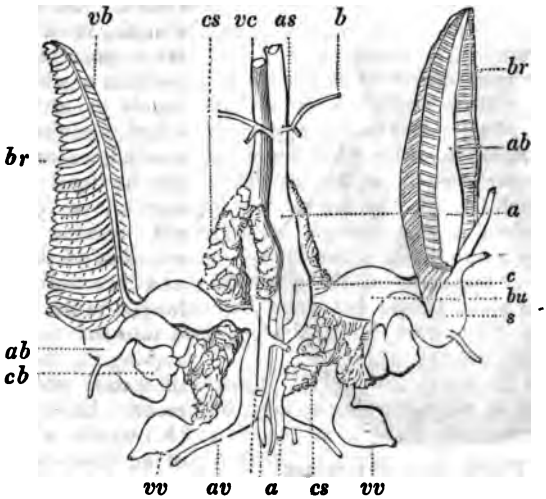

Fig. 9.—ORGANS OF CIRCULATION AND RESPIRATION IN THE CUTTLE-FISH.

Explanation of Fig. 9.—The organs of circulation and respiration of the cuttle-fish;—*c.* the aortic heart, the upper extremity of which is continuous with the superior aorta, which distributes the blood to the head, &c.;—*b.* branches of this vessel;—*a.* the inferior aorta which has a bulb at its origin and soon divides into two branches (*v,v,*);—*vc.* the vena cava, the parietes of which are covered by the spongy bodies, (*cs*);—*av.* veins of the viscera going to empty into the two branches of the vena cava;—*cb.* venous sinus or branchial heart;—*s.* swelling at the base of the branchial arteries;—*br.* branchiæ;—*ab.* branchial artery;—*vb.* branchial vein;—*bu.* bulb of the branchial veins, situate near the termination of these vessels in the heart.

4. What is the character of the heart in cephalopods? What are the peculiarities of the circulation?

branchial veins, (*vb*), the openings of which are furnished with valves, and then penetrates the arteries which arise from this organ. The latter vessels are two or three in number; but one of them is always much larger than the rest, and one of them also, has at its base a swelling or bulb, which is more or less muscular, and analogous to that found at the origin of the aorta in batrachians. The great artery to which we generally give the name of aorta, is carried forward and distributes its branches to a part of the viscera, the head and legs. The other arteries go to the viscera; and the blood, after having in this way passed through all the organs, returns by the veins, and is emptied by them into a great *vena cava*, situate near the heart. The branchial arteries arise from the inferior extremity of this last vessel, and, in the dibranchial cephalopods present a very remarkable arrangement; for, before penetrating the branchiæ each one of them dilates so as to form a great venous sinus, (*fig.* 9. *cb.*) which most authors regard as a branchial heart, but its parietes do not appear to be really muscular.

5. We see, therefore, that the circulation is here carried on in a manner opposite to that of fishes; for the heart is found in the track followed by the arterial blood, while in fishes the venous blood passes through this organ; but in other respects, there is a great resemblance in the general disposition of the circulatory apparatus of these two classes of animals; for, in both, the blood passes but once through the heart, and the whole of it traverses the respiratory apparatus before returning to the different organs.

6. On the vena cava and its principal branches we remark a multitude of very singular spongy bodies (*fig.* 9, *cs.*) which, when squeezed, yield a mucosity, and which are attached to the parietes of these vessels; these appendages are enclosed in two membranous pouches, which perform the functions of a pericardium, and at the same time communicate by particular openings with the branchial cavity. In this way the water from without laves them, and their interior, which is hollow, communicates by other holes with the interior of the veins, so that the blood must enter them. We know nothing certain in regard to their uses; but it is probable they are the seat of some secretion, and that they serve as a reservoir to contain the superabundant blood of the veins, when the circulation is interrupted in the vessels, much in the same manner as the spleen seems to do in the superior animals.

5. How does the circulation in cephalopods differ from that of fishes?
6. What is remarkable about the vena cava?

7. The apparatus of digestion is very complicated. The mouth is surrounded by a circular lip and armed with two vertical mandibles, which closely resemble the beak of a parrot; they are set in motion by powerful muscles. A fleshy tongue, furnished with papillæ and many horny pieces, occupies the interior of this cavity and is attached to a particular cartilage. Salivary glands, the number and arrangement of which vary a little, surround the pharynx and œsophagus, and pour into the alimentary canal the product of their secretion. The œsophagus contracts in general, and before terminating in the stomach, presents a large dilatation or crop (*fig.* 10, *j*;) but sometimes, this first digestive pouch is wanting. Commonly the stomach is in the form of an elongated sack; its parietes are muscular, and its structure reminds us of the gizzard of birds. A third cavity (*s*) succeeds this organ which, in dibranchial cephalopods, is in the form of a cœcum spirally folded, while in the tetrabranchial, it assumes that of a spherical sack internally lamel-

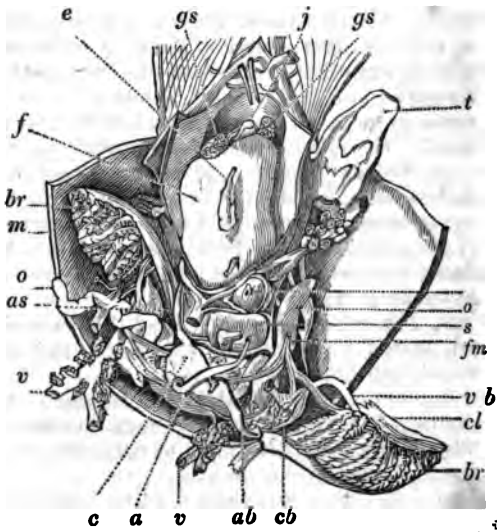

Fig. 10.—VISCERA OF A POULPE.

Explanation of Fig. 10.—Viscera of a Poulpe:—*j*. the crop situate beneath the cephalic cartilage;—*gs*. inferior salivary glands;—*f*. mass formed by the liver and ink-bag;—*e*. excretory duct of the ink-bag going to empty in the funnel;—*t*. this funnel or tube;—*m*. the open mantle;—*s*. the cœcum spirally folded;—*i*. a part of the intestine, the rest being removed to show the organs situate beneath;—*o*. the oviducts;—*c*. the heart;—*a*. the inferior aorta;—*as*. the superior aorta;—*vb*. the branchial veins;—*br*. the branchiæ —*cl*. the partition by which these organs adhere to the parietes of th respiratory cavity;—*ab*. the branchial arteries;—*cb*. venous sinus or b ıın chial hearts;—*v*. venæ cavæ;—*fm*. muscular fasciculi.

7. What organs constitute the apparatus of digestion in cephalo po ds? What is remarkable about the mouth? What is the character of th stomach? What is the nature of the liver?

lated: the bile is poured into this cavity by two canals. The liver is very voluminous, sometimes simple, and sometimes divided into two or more lobes; its colour is reddish yellow and its texture very soft. The intestine, which arises very near the cardiac orifice, is simple and communicates, at a short distance from the pylorus with a glandular pouch which seems to be analogous to the pancreas; and, after making several curves, this tube empties into the branchial cavity, at the base of the funnel through which the water escapes that has served the purposes of respiration.

8. In dibranchial cephalopods, there exists in the neighbourhood of the liver another very remarkable secretory organ, which produces in abundance a blackish liquid, called *ink*; the excretory duct of this gland (*fig.* 10 *e.*) empties into the intestine near its extremity, and, when the animal is in danger, pours out, through the funnel or tube, enough of this liquid to darken the water around, and thus conceal itself from the sight of its enemies. The ink of one of these cephalopods, the cuttle-fish, is employed in painting, under the name of Sepia, and many authors suppose that the Indian ink of the Chinese is an analogous substance, though it appears the material commonly used in the manufacture of Indian ink is nothing but very finely powdered charcoal. The tetrabranchial cephalopods do not possess anything similar.

9. It has been already stated that mollusks have no solid, articulated frame within their body, similar to the skeleton of vertebrate animals. In the cephalopods, however, we find traces of something analogous; for there exists in the head a cartilage which not only protects the brain, but enlarges the head in different directions, to furnish points of insertion to the principal muscles of the animal.

10. The disposition of the organs of locomotion and prehension, which are fixed around the mouth, varies in these animals. In the dibranchial cephalopods, there is a crown of eight or ten large fleshy tentacula, the inferior surface of which is furnished with suckers, like cupping glasses, by aid of which they fix themselves very strongly to bodies that they embrace (*see fig.* 7, *page* 23). In the tetrabranchial cephalopods, on the contrary, these appendages, though very numerous, are slender and unprovided with suckers.

8. What is Sepia? How is it formed? What is Indian ink?

9. Have cephalopods anything resembling an internal skeleton?

10. What is the disposition of the organs of locomotion?

11. The organs of the senses are most perfect in the dibranchial cephalopods. In these mollusks there are two very large eyes of spheroidal form, lodged in the lateral parts of the head. These organs are composed of a transparent cornea, let into the skin and sometimes protected by a fold, like an eyelid, a crystalline lens, a vitreous body, a retina, a choroid coat, a sclerotica &c., nearly the same as in vertebrate animals. In the tetrabranchial cephalopods the eyes are borne on projecting peduncles and consist only of a cavity, the black interior of which contains a retina and receives the luminous rays through a circular opening. No auditory apparatus has yet been discovered in the first of these two families. We find in the cephalic cartilage of the latter two small cavities closed on all sides, except at the point through which the nerve penetrates; they lodge a membranous vesicle, and are filled with a peculiar fluid, containing a small stone. This, as we see, is a still more simple arrangement than that of fishes; for the whole apparatus is reduced to a vestibule and a nerve only.

12. The nervous system of the cephalopods is more complicated than that of the other mollusks, and the different ganglia, grouped around the œsophagus, have a greater tendency to become confounded in a single mass. The medullary collar, thus formed, is composed of three pairs of ganglia, namely: the cephalic ganglia (*fig.* 11 *c.*), the tentacular ganglia (*t*) and the thoracic ganglia (*g*); the two first pairs are placed above the œsophagus and, by joining the first, form a double collar around this tube; sometimes they are very distinct, but at others, they are almost entirely confounded. The cephalic ganglia give rise laterally to two large nervous cords, which, from their origin, enlarge into ganglia and then furnish the optic nerves; from this species of brain, nerves also arise, which go to the mouth, and sometimes form around this opening a new collar furnished with two pairs of small ganglia (*fig.* 5, *page* 17). The tentacular ganglia afford origin to the nerves of the feet or tentacula, which, before ramifying on these organs, also present ganglionic swellings. Finally the thoracic ganglia, sometimes very distinct from the preceding are at others, confounded with them (*see fig.* 6. *p.* 21), furnish many nerves, the most important of which are: 1*st.* the two nerves of the viscera (*fig.* 11. *v*) which in their course present a pair of ganglia and distribute their branches to the branchiæ, the heart, stomach &c.; 2*nd.* the

11. Where are the eyes situated in cephalopods? Are cephalopods capable of hearing?

12. What is the general character of the nervous system of cephalopods?

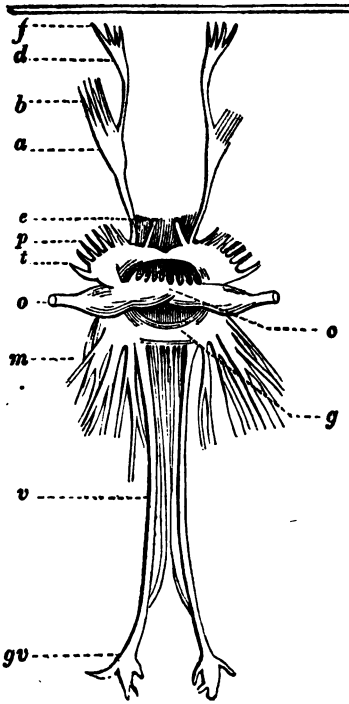

Fig. 11.—NERVOUS SYSTEM OF THE NAUTILUS.

nerves of the mantle, which, in the dibranchial cephalopods also terminate in ganglia, from which arise a great many filaments. In the tetrabranchial cephalopods, the œsophageal collar is simply protected by the cephalic cartilage; but, in the dibranchial cephalopods in which the nervous system acquires its highest degree of developement, this medullary mass is lodged in a special cavity, hollowed in the cartilage through which the œsophagus passes.

13. The cephalopods are never hermaphrodite as are most others of the mollusca. The ovary is always simple and lodged at the bottom of a sac formed by the body of the animal; sometimes there is but a single oviduct; at others, we find two, which open at the base of the funnel; finally, all these animals are oviparous.

14. All these mollusks are marine: they are very voracious and feed chiefly on crustacea and fishes, which they seize by the aid of their supple and vigorous arms, and easily devour by means of their sharp mandibles. Their flesh is eaten.

15. This class is divided into two families.

Explanation of Fig. 11.—Nervous system of the Nautilus:—*c*, the brain; —*o*, the optic nerves;—*g*. the sub-œsophageal or thoracic ganglia;—*t*. the tentacular ganglia;—*p*. nerves of the tentacula;—*e*. the nerves of the funnel; —*a*. a ganglion from which arise other tentacular nerves, (*b*);—*d*. a second, and similar ganglion, also giving rise to tentacular nerves (f_1);—*m*. nerves of the mantle, &c.—*v*. the great visceral nerves, each of which gives rise to a ganglion, (gv_1) from which the principal nerves of the viscera take their origin.

13. Do cephalopods lay eggs?

14. Where are cephalopods found? Upon what do they feed?

15. How is the class of cephalopods divided?

16. The family of CEPHALOPODA, DIBRANCHIATA,—or ACETABULIFERA,—that is, cupping-glass bearers, is very numerous. In it are placed the poulpes, cuttle-fishes, calmaries, argonauts, &c. Most of these mollusks have no external shell, and their naked skin includes a great number of contractile vesicles, filled with differently coloured fluids, which, by alternately contracting and expanding, produce and cause again to disappear in turn, often very brilliant spots; but we find in their interior a more or less developed shell, situate on the back. This shell is largest in the cuttle-fishes: it is oval and composed for the most part of a great number of transverse calcareous laminæ: it is very common on the sea shore, and is generally known under the name of *cuttle-fish bone*. In the calmaries it is of a horny consistence and in its form resembles a feather, or lamella; and in the poulpes it is merely represented by two horny stylets, lodged in the thickness of the mantle.

17. The tentacula of these cephalopods form a simple crown around the mouth, and bear on their internal face, circular cups or suckers, the number of which varies from eight to ten. In the following family we shall find an entirely different arrangement.

18. The POULPES,—*Octopus*,—(*Fig.* 7. *Page* 23.) are easily recognised by their naked body, which is in the form of an oval sack, unprovided with fins, and their eight very large and nearly equal feet. They make use of these last organs to seize their prey as well as to swim and crawl upon the ground, and are even formidable to swimmers on account of the force with which they press those bodies they embrace. These animals are essentially carnivorous. Their size is often very great: there is one species in the Pacific Ocean which attains about six feet in length; these mollusks are objects of terror to the natives of the Polynesian Islands, who dive to the bottom of the sea for shells; but their size and strength are wonderfully exaggerated. Pliny, speaks of a poulpe that had arms thirty-feet long, and a modern author gravely relates the history of one of these gigantic mollusks, which, attacking a vessel nearly upset it. The *Common Poulpe*,—*Sepia Octopodia*,—is about two feet long; it inhabits the coasts of Europe and commonly keeps among rocks: it destroys a great many fishes and crustacea.

16. What are the general characters of the cephalopoda dibranchiata? What is cuttle-fish bone?

17. How are the tentacula of cephalopods arranged?

18. What are the general characters of the Poulpes? What is the nature of their food? Where are they found?

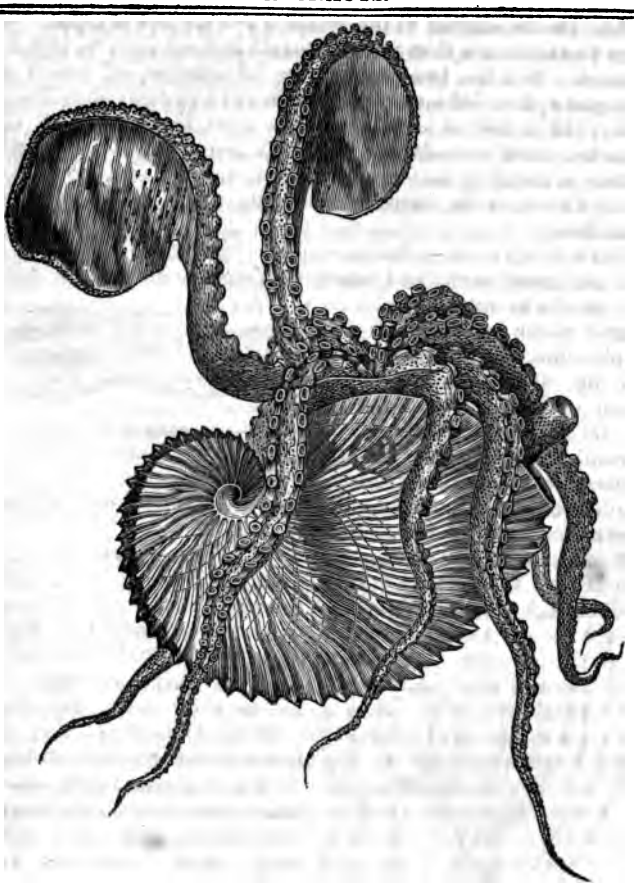

Fig. 12.—ARGONAUT.

19. The ARGONAUTS,—*Argonauta*,—(*Fig.* 12.)—are cephalopods very closely allied to the Poulpe, but the pair of feet which is nearest the back, is dilated at the extremity into a broad membrane, and the body is always lodged in a very delicate and extremely beautiful shell, (vulgarly called the *paper nautilus*.) It is not certainly known however, whether this shell really belongs to the animal that inhabits it, or whether it is derived from some other mollusk. Be this as it may, the cephalopod does not adhere to it, but uses it as a boat

19. What are the general characters of the Argonaut?

to float on the surface of the water when the sea is calm. Six of its tentacula are then folded beneath and act as oars, and it is pretended that the two others, the extremities of which are enlarged and raised up and spread for sails, as represented in the figure, (12;) but we should not infer from their structure that these tentacula are adapted to such a purpose. The common species is found in the Mediterranean, the Indian Ocean, &c.: it was known to the ancients under the name of *nautilus*, and *pompilius*.

The CALMARIES,—*Loligo*,—differ from the preceding in their elongated sack, and being provided with two terminal fins, by the horny lamina, lodged in the back, which supplies the place of shell, and by their tentacula which are ten in number, and not of the same configuration throughout, (*fig.* 13.) Eight of these feet are of moderate size, and are armed with little cups in their whole length, while the two others are very much elongated and have cups only near their extremities.

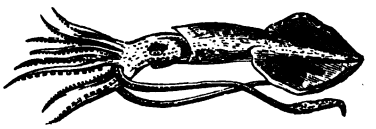

Fig. 13.—THE COMMON CALMARY.

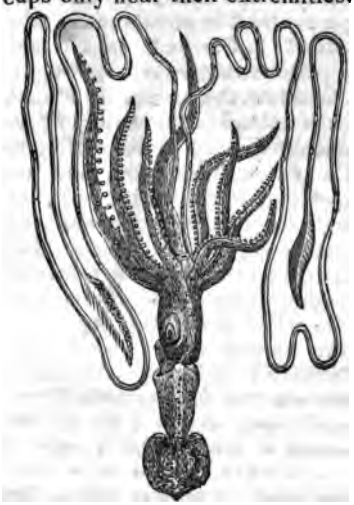

Fig. 14.—THE CALMARET.

21. The CALMARETS, —*Loligopsis*, — are remarkable for the great length of two of their arms, (*fig.* 14.) which are filiform, and widened at the end only; in other respects they differ but little from the Calmaries: they are found in the Mediterranean.

22. Certain cephalopods, which resemble the Calmaries very much, but have their long arms furnished with hooks, form the genus of *Onychoteuthis*, (from the Greek *onux*, in the genitive *onuchos*, nail, and *teuthis*, a calmary,) that is, a calmary with nails.

23. The CUTTLE-FISHES, —*Sepia*,—have the tentacular

20. How do the Calamaries differ from the Argonauts?
21. What are Calmarets?
22. What is the ony'choteuthis? (pronounced *o-ni-ko-tu-this.*)
23. What are the general characters of the cuttle-fish? Of what use is cuttle-fish bone?

appendages arranged like the calmaries; but their body, which is oval and depressed, is furnished with fleshy, lateral fins, occupying the whole length of the sack, and the back is sustained by a large internal shell, the structure of which has been already mentioned. The species most commonly found in the seas of Europe,—*Sepia officinalis*,—attains a foot in length or more. The cuttle-fish bone or shell, in powder, is used as a dentrifice, and is employed in the arts for several purposes, as for polishing, for forming moulds for silver castings, and as a pounce.

24. The family of CEPHALOPODA TETRABRANCHIATA, has for its type, the NAUTILUS, a very remarkable mollusk, the body of which is enclosed in the last chamber, (*a.*) of a large shell, folded spirally and divided by transverse partitions (*b.*) into several cavities, (*Fig.* 15.) Each one of these partitions is pierced by a hole, and the canal thus formed, which is called the syphon (*s.*) extends to the posterior extremity of the shell; it is traversed by a contractile membranous tube, posterior to the body of the animal. This structure seems designed to facilitate the ascent or descent of the animal in the water, by increasing or diminishing the specific gravity of the shell; for the syphon communicates with an external reservoir, and can empty or distend itself with the water found in it; now, the chambers which it passes through are filled with air, and when this tube becomes inflated, it must compress this elastic fluid, and increase its density, which, at the same time augments the specific gravity of the whole shell, and must give it a tendency to sink towards the bottom of the water in which it floats.

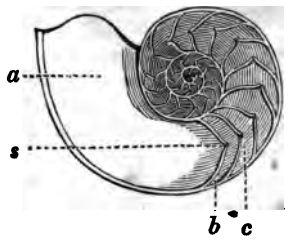

Fig. 15.—SECTION OF A NAUTILUS.

25. The conformation of the animal differs very much from that of the Poulpes, Calmaries and other dibranchial cephalopods. The head of the nautilus is surrounded by a large, fleshy disk, which bears some analogy to the foot of the gasteropods, and probably serves the animal in

Explanation of Fig. 15.—Vertical section of the nautilus shell:—*a.* the last chamber, in which the animal is lodged;—*b.* one of the partitions which divides the chambers (*c.*) from each other;—*s.* the syphon.

24. What are the peculiarities of the nautilus shell? What seems to be the object of this peculiar structure?

25. How is the animal of the nautilus characterised?

crawling. The tentacula which are inserted near the mouth, are not furnished with cups as in the preceding family: they are retractile and in considerable number. The eyes are pedunculate, that is, supported on a sort of foot-stalk or stem: there is no organ of hearing, nor pouch, nor fins, and the branchiæ are four in number.

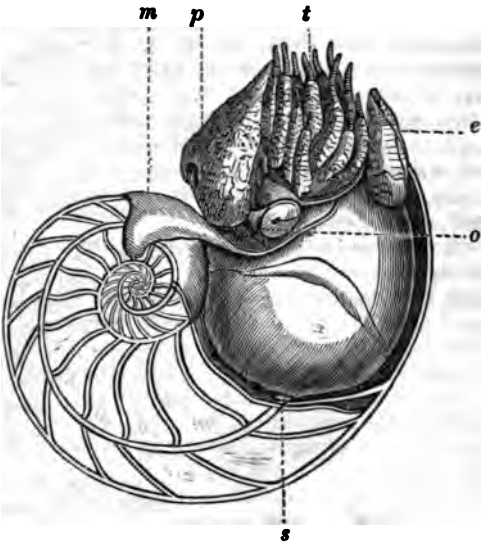

Fig. 16.—NAUTILUS.

26. A great number of shells are found in the fossil state which are very analogous in structure to the nautilus and which probably belonged to cephalopods of similar conformation; they are the AMMONITES, (*fig.* 17) vulgarly called *Horns of Ammon* in consequence of the resemblance of their volutes or whorls to those of a ram's horn. These animals were among the most ancient inhabitants of the earth and lived in every sea. Their remains abound in the secondary formations and are met with in all parts of the world; but they have long since disappeared from the surface of the earth, and, in those layers which rest upon the chalk, not even a trace of them is found. Consequently, their destruction must have occurred at a period long anterior to the creation of nearly all the mammals: they vary much in form

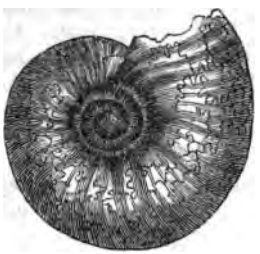

Fig. 17.—AMMONITE.

Explanation of Fig. 16.—The nautilus shell opened:—*t.* the tentacula;—*e.* the funnel or reservoir;—*p.* the foot;—*m.* part of the mantle;—*o.* the eye;—*s.* the syphon.

26. What are ammonites? Where are they found?

and still more in size; some are not larger than a bean, and others are more than four feet in diameter. More than three hundred species of them are known, and they are divided into several genera according to the manner in which the shell is rolled, the position of the syphon, the form of the partitions &c.

27. We give the name of BELEMNITES (from the Greek *belemnon*, a dart) to other fossils, which also seem to have belonged to the cephalopods, but which, in place of being an external shell, must have been lodged in the interior of the animal, like the bone of the cuttle-fish. They are conical in form, and are chiefly composed of a series of little horns, fitting one in the other like boxes in a nest, traversed by a syphon and terminated anteriorly by a horny plate, that forms a sort of chamber, in the interior of which we sometimes find the remains of an ink-bag, similar to the sack which fulfils the same purposes in the naked cephalopods. The belemnites are not met with in strata as old as the ammonites; but they abound in the middle and upper layers of the secondary formation, and cease to exist in the upper layers of the chalk.

Until lately, a host of microscopic shells of lenticular form and without apparent opening, designated by authors under the names of NUMMULITES, (from the Latin *numma*, a peice of money), CAMERINES, (from the Latin *camera*, chamber) FORAMINIFERA (from the Latin *foramen* a hole and *fero*, I bear) &c. were referred to the order of cephalopods; these little bodies abound to such an extent in certain soils, that they of themselves exclusively, constitute chains of hills and immense banks of building stone; but they are also found in European seas, and, on observing them when alive, we are convinced that the animals to which they belong do not resemble either the cephalopods or even the mollusks, in anything: they are beings of a very peculiar structure and seem more to approximate the polypi.

27. What are Belemnites? What are their characters? Where are they found?

LESSON III.

CLASS OF GASTEROPODA—*General conformation—Classification.*

ORDER OF GASTEROPODA PULMONEA — *Organization — Division into two families.*

FAMILY OF TERRESTRIAL PULMONEA—*Limax—Vaginulus —Helix—Bulimus—Pupa—Chondrus—Clausilia—Achatina*

FAMILY OF AQUATIC PULMONEA—*Onchidium—Planorbis. —Limnæus—Physa——Auricula.*

ORDER OF GASTEROPODA PECTINIBRANCHIATA—*Organi—zation—Classification.*

FAMILY OF TROCHOIDES—*Trochus—Turbo—Delphinula— —Turritella— Cyclostoma — Valvata—Paludina—Littorina. —Monodon—Phasianella— Ampullaria—Janthina—Nerita.*

CLASS OF GASTEROPODA.

1. Mollusks that are provided with a head, and crawl upon the belly, or swim by means of a fin formed of this part of the body, constitute a very numerous class, the type of which is the slug and snail. The body is elongated, and terminated anteriorly by a more or less developed head, which ordinarily has tentacula inserted above the mouth; the back is furnished with a mantle, which extends more or less, and the belly is covered by a fleshy mass, which is generally in form of a broad disk, (*fig.* 18.), and serves the animal for crawling on the ground, but which is sometimes very much compressed and then constitutes a vertical fin (*fig.* 78). — Many of these animals are entirely naked; others have an internal shell concealed in the thickness of the mantle; but most of them have an external shell, and this calcareous envelope is almost always sufficiently large to contain them entirely, and afford them protection.

Fig. 18.—LIMNÆA,—FRESH WATER SNAIL.

1. What is the general character of the class of gasteropods? Have they any shell.

2. The arrangement of these shells varies much; sometimes they are composed of many pieces, at others, of a single piece; sometimes they are symmetrical, at others not symmetrical, and in this last case, in proportion as they are elongated, they are rolled or twisted upon themselves, and constitute a spirally twisted cone. This last form, which is seen in the shell of the snail, is the most common in gasteropods, and presents numerous varieties. Sometimes the part which grows less rapidly and upon which the cone rolls itself is full (*fig.* 19), and sometimes empty; it is called *columella* or pillar (*c*) and, when empty, we give the name of *umbilicus* to this opening (*fig.* 20 *u*). If the turns of the shell remain in the same plane the *spire* is flat or concave, and the general form of the shell is discoid—resembling a disk, as in the planorbis (*fig.* 29); sometimes the height of each turn completely envelopes the preceding involutions, so that the spire is concealed; but in most cases the turns are inclined towards the edge of the columella, and there results an oblique spire, which is more acute in proportion as the cone is less rapidly widened (*fig.* 19). Those *shells* are called *turbinated*, in which the first turns are raised up above the succeeding ones, (*fig.* 19), forming a projecting spire, and it is remarked that the turns or whorls are almost always directed *from* the right side. Sometimes however the spire of these turbinated shells is turned *from* the left side of the animal (*fig.* 25), and in this case, they are said to be *perverse*.

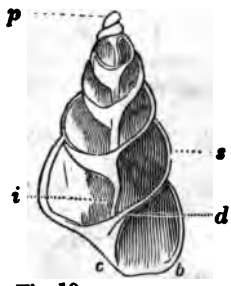

Fig. 19.—SECTION OF A TURBINATED SHELL.

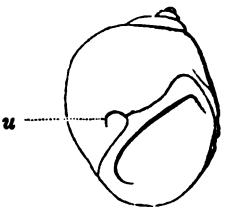

Fig. 20.—NATICA.

Explanation of Fig. 19.—Section of a turbinated shell to show how it is spirally wound upon itself:—*b*, the mouth or aperture of the shell;—*c*. the columella;—*d*. part of the columella included in the last turn of the spire;—*s*. turn of the spire next to the last;—*p*. the apex or summit of the shell;—*i*. part of the columella.

2. Do the shells of gasteropods consist of a single piece? What is meant by the *columella*? What is the *umbilicus*? What is meant by a *turbinated* shell? What is meant by a *perverse* shell?

8. The mass of the viscera occupies the upper part of the cone formed by these shells, and always remains enclosed in it; but the head and foot project externally when the animal extends itself to walk, and return again into the last turn of the spire, when it contracts: and the size of this latter part of the shell and the form of its opening are always in relative proportion to the foot. In most of the aquatic gasteropod mollusks, with a spiral shell, there is a horny or calcareous disk or door, called *operculum* (*fig.* 32*o.*), which is fixed to the posterior part of the foot, and which closes the entrance of the shell, when the animal retires into it. The *operculum* of certain small shells constitutes what is vulgarly termed an *eye-stone*.

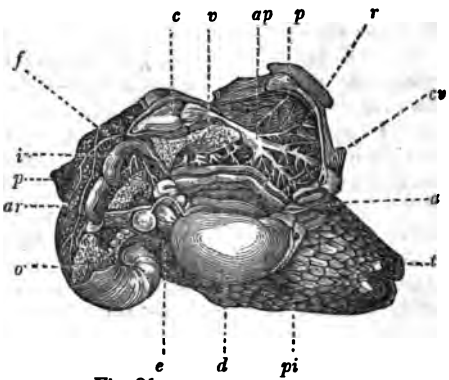

Fig. 21.—ANATOMY OF A SNAIL.

4. The organs of respiration are formed sometimes for breathing the air, and sometimes for aquatic respiration; but, in mollusks with a spiral shell, they are always lodged in the last turn of the spire and receive the ambient element beneath its edge, either by a hole pierced through the mantle, or between the body and the free edge of this cutaneous fold, which is also often prolonged into a canal by means of which the animal can obtain the fluid (whether air or water), necessary

Explanation of Fig. 21.—Anatomy of a snail;—*pi.* the foot;—*t.* the tentacles partly contracted;—*d.* a sort of diaphragm which separates the respiratory cavity from the other viscera;—*e.* a portion of the stomach;—*f.* the liver;—*o.* the ovary;—*i.* the intestines;—*r.* the rectum;—*a.* the anus;—*c.* the heart, (the pericardium,—the sack containing the heart—being open;—*ap.* the pulmonary artery ramifying on the parietes of the pulmonary cavity, (*p.*);—*v.* the gland which secretes the viscosity;—*cv.* its excretory canal, going to open near the anus.

3. In what part of spiral shells are the viscera of the animal contained? What part of the shell contains the head and foot? What is the *operculum*? What are eye-stones?

4. In what part of the spiral shells are the organs of respiration placed? By what means is the air or water admitted to these organs? Where is the respiratory tube situated?

for its respiration, without putting its head or foot out of its shell. In this latter case, the shell has on its edge a notch or canal, destined to lodge the respiratory tube; this notch is near the termination of the columella, and on the side opposite to that towards which the spire is directed. Consequently this canal is to the left, in the common species, and to the right, in perverse shells.

5. The heart (*fig.* 21 *c.*) is always aortic: it is generally composed of an auricle and a ventricle, and its position, as is the case with the respiratory tube, is in relation to the direction of the spire of the shell. This organ is situate on the same side with the tube, that is, on the side opposite to that towards which the shell turns, and the procreative organs (the form of which varies much), are always placed on this latter side, and consequently on the side opposite to the heart.

6. The mouth is surrounded by contractile lips, and sometimes armed with horny teeth which occupy the palate. In many other animals of this class, the anterior part of the œsophagus is very fleshy, and possesses the faculty of projecting itself externally, in such a manner as to constitute a trunk. Sometimes the stomach is also furnished with cartilaginous or bony pieces, proper for dividing food; the intestine is folded on itself and lodged between the lobes of the liver and ovary; and the anus (*fig.* 21 *a.*) is almost always situate on the right side of the body.

7. In this class, the organs of the senses are less developed than in the cephalopods; the tentacles, which most gasteropods bear on their front, varying in number, from two to six, serve chiefly for tact and perhaps for smell. No organ of hearing has been found, and their eyes, which are sometimes wanting, are very small, and of a very simple structure: they resemble those of the nautilus, and are sometimes adherent to the head, and sometimes borne at the base on the side, or at the end of the tentacula.

8. The class of gasteropods is divided into eight orders, the principal characteristics of which are derived from the disposition of the branchial (*brank-e-al*) apparatus, as may be seen in the following table:

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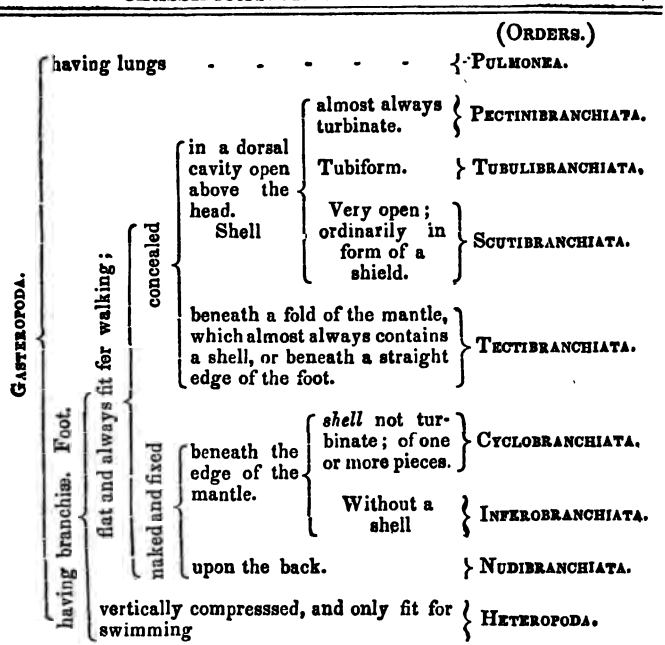
5. What is the character of the heart in ga'steropods?

6. What are the peculiarities of the digestive organs?

7. Where are the tenta'cula placed? What is the number of tentacles in ga'steropods? Where are their eyes situated?

8. Into how many orders is the class of ga'steropods divided? Upon what are these divisions founded?



ORDER OF GASTEROPODA PULMONEA.

9. Gasteropods formed for aerial respiration have no branchiæ, but have a cavity on the back, upon the parietes of which the pulmonary vessels form a complicated net work, (*See fig.* 21, *page* 39.) and the lung receives the external air through a hole in the edge of the mantle above the right side of the nape which is susceptible of being opened or shut at the will of the animal. All the pulmonic gasteropods are not however terrestrial mollusks. Many of them live in the water; but then they are obliged to come to the surface from time to time, to obtain air necessary for their respiration. All these animals feed on vegetable substances.

10. The order of pulmonic gasteropods is divided into two families: the *terrestrial pulmonea*, and the *aquatic pulmonea*.

11. The FAMILY OF PULMONEA TERRESTRIA, are generally recognised with ease by their four tentacles. These appendages are retractile, and those forming the upper pair, which

9. What are the general characters of the breathing apparatus of the order of Gasteropoda Pulmonea? Upon what do they feed?
10. How is the order of pulmonic gasteropods divided?
11. What are the characters of the family of terrestrial pulmonea?

are longest, have the eyes at their extremities. The mouth is armed with one palatine tooth, and a small tongue studded with microscopic teeth; and the body varies in form; some are naked or only provided with an internal shell, while others have an external shell spirally twisted, with a blunt summit, and the mouth without a notch. The small tribe formed by the first is divided into *Limax*, *Vaginula*, &c. The tribe of terrestrial pulmonea with an external shell comprises the genera of *helix*, *vitrina*, *bulimus*, *pupa*, *chondrus*, *succinea*, *clausilia*, and *achatina*.

12. The LIMACES, (Slugs) form the type of the terrestrial pulmonea without apparent shell. The body, as every one knows, is elongated, and their mantle is a fleshy disk, scarcely separated from the rest of the skin, (*fig.* 22. *m.*) and which only occupies the fore part of the back, where it covers the pulmonary cavity; it often encloses in its thickness a small, flat shell. On the right side of this species of shield, there is a notch, at the bottom of which we observe a contractile opening (*fig.* 22. *ro.*) that leads into the pulmonary cavity; the anus is situate upon the anterior border of this respiratory orifice, and a third opening belonging to the procreative apparatus is situate on the external side of the base of the right superior tentacle. The four tentacula are cylindrical, more or less swelled at the end, and hollow; they are drawn in and pushed out, on unrolling themselves like the inverted fingers of a glove, by the aid of muscular fibres lodged in their interior; the eyes, which are borne on the ends of the superior tentacles, (*fig.* 22, *st.*) are black; the mouth is armed with a sort of palatine tooth, in the form of a crescent, and a smooth tongue. The heart is lodged in a particular cavity beneath the mantle, and is composed of an oval auricle, which receives a large pulmonary vein, and a pear-shaped ventricle, from which the aorta arises. And there exists near the heart a secretory apparatus which pours out a viscid matter upon the external surface, through an excretory canal, opening near the respiratory orifice.

13. These animals are herbivorous: they feed principally upon young plants, fruits, mushrooms, and are most voracious towards evening. During the heat of the day they remain concealed in holes under stones, or some heap of half decayed leaves, or even in the earth, and they seldom go out except in the morning and evening when the air is humid: they are especially abundant after rain. During the cold season they bury themselves in the ground and remain torpid.

12. What are the general characters of the Limaces?

13. Upon what do the Limaces feed? Where are they found? What becomes of them in the cold season?

14. Some, called ARIONS, have the pulmonary orifice situate near the anterior part of the dorsal shield, such as the *Limax rufus*, which is every where met with in wet weather. [A decoction of this species is sometimes used in France for pulmonary disorders:] the others, named Limax properly so

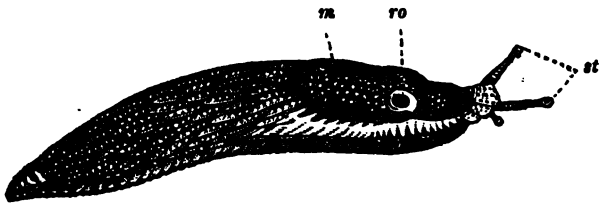


Fig. 22.—LIMAX RUFUS.

called, or Lima, have this orifice situate more posteriorly and frequently have a pretty well formed internal shell; the *limax cinereus*, which inhabits caves and shady forests, belongs to this division as well as the *Limax agrestis*, which abounds in some countries, and is very injurious to agriculture.

We give the names of VAGINULA, TESTACELLA, and PARMACELLA to other naked gasteropods, nearly resembling the limaces, but which differ from them in the position of the anus, the extent of the mantle, &c.

15. The SNAILS,—*Helix*,—form the most important tribe of terrestrial pulmonea with a complete and apparent shell. Their organization differs very little from that of the limaces; the mantle, instead of being in the form of a convex shield, constitutes a large cone twisted on itself, containing the viscera, which is covered by the shell, (*fig.* 21, *p.* 39.) We distinguish them by their shell, the opening of which is ordinarily raised like a pad or collar, forming a thickened lip in the adult; the shell is a little twisted by the projection of the penultimate whorl of the spire, and in this way takes somewhat of a crescent shape. In snails properly so called, this opening is at least as broad as high, and the shell is sometimes globular and sometimes depressed. The habits of these mollusks are nearly the same as those of the limaces. In summer, they are very voracious, but in the autumn they eat very little, and, on the approach of

Explanation of Fig. 22.—*Limax rufus*:—*st.* the eyes on the extremity of the superior testacles;—*m.* the mantle;—*ro.* the notch over the pulmonary cavity?

14. What are Arions?

15. What are the general characters of snails? What are their habits? Do their wounds heal? In what respect does the genus Helix differ from the genus Limax?

winter, they retire into some hole, draw themselves into their shell, shutting up the mouth with a calcareous matter, secreted by the edge of the mantle, and remain torpid until spring. Very curious, and frequently repeated experiments, have proved that not only do wounds inflicted on these animals readily heal, but that considerable portions of the body after being removed, can be renewed. The eyes, the tentacles, and even the head of snails have been known to be entirely renewed in this way. A very great number of species of snails are known; they are found in all parts of the world.

Fig. 23. BULIMUS.

16. We give the name of VITRINA to snails the shell of which is very thin, flattened and unprovided with a thickened lip, and too small to enclose the body entirely; some small species are found in Europe. The BULIMES,—*Bulimus*,—(*fig.* 23) have an elongated shell, the opening higher than wide, furnished with a thickened lip, and without notches. A small species, which is found in France, is remarkable for the singular habit of successively breaking the whorls of the apex of the shell. There is a large species in Brazil which is eaten as a delicacy. Other mollusks of the same tribe, the genus *Pupa*, have an ellipsoid, or even almost cylindrical shell, with the opening higher than wide furnished with a thickened, notched, and generally dentate lip, (*fig.* 24.) they are of small size, and live in humid places, among moss, &c.

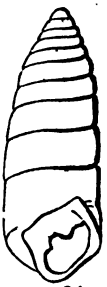


Fig. 24. PUPA.

Fig. 25. CLAUSILIA LÆVIS.

Shells of the genus *Chondrus*, also have a notched and dentate lip; but their form is more ovoid.

17. The genus of CLAUSILIA, is composed of small mollusks which live in moss, at the roots of trees, and have a shell similar to that of the Pupa, but much more slender and pointed, (*fig.* 25.)

18. The AMBRETTES,—*Succinea*,—differ from all the preceding in the absence of a thickened lip around the opening of the shell, which is oval, and too small

16. What is the Vitrina? What are the characters of the genus Bulimus? How is the genus Pupa distinguished?

17. Of what is the genus Clausilia composed?

18. What are the distinguishing marks of the Ambrettes? Where are they found?

Fig. 26. AMBRETTE.

to lodge the entire animal, (*fig.* 26.): the shell is thin and translucent, and obtains its name from a supposed resemblance to amber: they live upon plants that grow along the margins of rivulets and brooks.

19. The genus of ACHATINA, (*fig.* 27.) is composed of large snails, which, in warm countries, feed on shrubs; they have an oblong shell with the opening wider than it is high, without a thickened lip, and truncate at the extremity of the columella, a disposition somewhat analogous to that of the shell of most marine gasteropods.

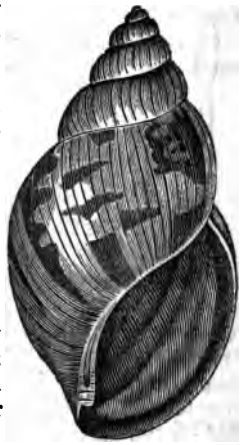


Fig. 27.—ACHATINA.

20. The family of PULMONEA AQUATICA have but two tentacles, (*fig.* 18, *page* 37); their mode of respiration obliges them to come frequently to the surface of the water to breathe: they cannot keep at great depths, and they ordinarily live in fresh waters, or near coasts.

21. As in the preceding family we find here mollusks without a shell, and others that are provided with one: the first form the genus of *Onchidium* (*fig.* 28) which have a very straight, and very extensible elongated body; they inhabit the fresh waters of the

Fig. 28.—ONCHIDIUM LÆVE.

19. What shells form the genus of Achatina? (pronounced *ak-a-te-na.*)
20. What are the characters of the family of pulmonea aquatica?
21. What are the characters of the genus Onchidium?

warm parts of both continents: the second are subdivided into the genera of PLANORBIS, LIMNÆA, AURICULA, &c.

22. The mollusks of the genus PLANORBIS have a thin shell, rolled upon the same plane, which is consequently discoid, and the whorls very gradually increase in size (*fig.* 29.) Their tentacles are long and filiform, and the eyes are placed at the internal side of their base. These gasteropods feed on vegetable substances, and inhabit stagnant waters; in winter they bury themselves in the mud, and lie torpid.

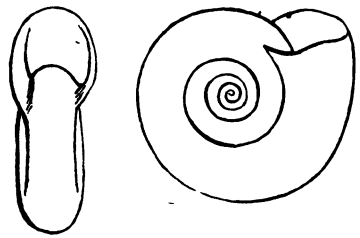


Fig. 29.—PLANORBIS.

23. The LIMNÆA (*fig.* 18, *page* 37) have the same habits, and are almost always found in the same localities as the Planorbis, from which they are readily distinguished by the form of their shell, the spire of which is oblong; their tentacles are thick and triangular. In the laying season, they are often found in great numbers joined together, so as to form a sort of chaplet. They swim on the back with the ventral disk extended on the surface of the water, and, in winter they become torpid like the planorbis.

Fig. 30. PHYSA.

24. We give the name of PHYSA to small mollusks found in fountains, the shell of which (*fig.* 30.) is similar to that of the limnæa, but very thin, without a thick lip, and without a fold on the columella. The animal, when it crawls or swims, covers its shell with the two lobes of its mantle. In other respects it closely resembles the limnæa.

Fig. 31. AURICULA.

25. The AURICULÆ differ from the preceding by having large oblique grooves upon the columella of their shell, which is oval or oblong, (*fig.* 31.) The name is derived from the shape of the opening,

22. What are the characters of the genus planorbis? Upon what do animals of this genus feed? Where are they found?

23. How is the genus Limnæ'a distinguished from the genus planorbis? What are the habits of this genus?

24. What are the characters of the genus Physa?

25. How is the genus auri'cula characterised? (Auri'cula is formed from the Latin, *auris*, ear, and means a little ear.)

resembling a human ear. Many of these gasteropods are of considerable size. One species is found on the shores of the Mediterranean.

ORDER OF PECTINIBRANCHIATA.

26. This division of the class of Gasteropods is the most numerous in genera and species: it comprises nearly all the mollusca, in which the shell is univalve and spirally twisted, and many of those in which the shell is simply conical. The

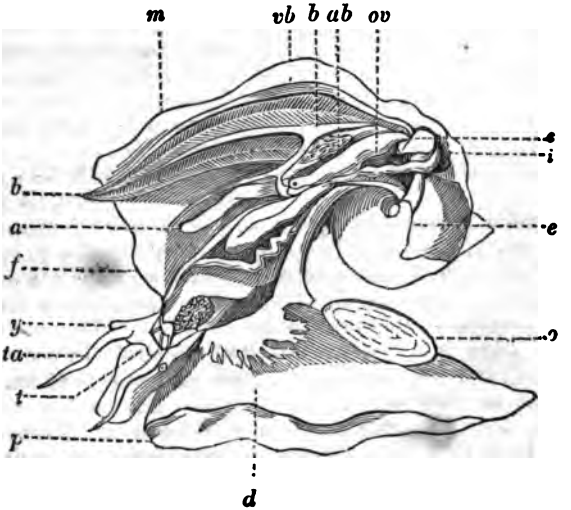


Fig. 32.—ANATOMY OF A PECTINIBRANCH GASTEROPOD. *Turbo Pica* (*See Fig.* 44.)

Explanation of Fig. 32.—Anatomy of a pectinibranch gasteropod, (the *Turbo pica*, to show the arrangement of the respiratory cavity:—*p.* the foot of the animal;—*o.* the operculum;—*t.* the trunk;—*ta.* the tentacles;—*y.* the eyes;—*m.* the mantle, split open longitudinally so as to expose the respiratory cavity: *f.* the anterior edge of the mantle, which, in its natural position covers the back of the animal, and leaves there an opening or great slit through which the water reaches the branchiæ:—*b.* the branchiæ;—*vb.* the branchial vein which goes to the heart, (*c*;)—*ab.* the branchial artery;—*a.* the anus;—*i.* the intestine;—*e.* the stomach and liver;—*ov.* the oviduct. Above the nucha or nape, we see the cephalic (nervous) ganglion, and the salivary glands;—*d.* fringed membrane, which below borders the left side of the opening of the respiratory cavity.

*Pec'tinibranchia'ta.—From the Latin, *pecten*, a comb, and *branchiæ*, gills —because the branchiæ or gills (*fig.* 32 *b.*) resemble a comb in form.

26. What are the peculiarities of the pectinibranch gasteropods? In what parts of the shell do we find the respiratory cavity?

most remarkable feature of almost all these animals is the arrangement of their branchial apparatus; but this character is not constant; for, in two genera (cyclostoma and helicina), which, in other respects, are too nearly allied to the ordinary pectinibranchiata to be separated from them, there are no branchiæ, and their respiration which is aërial as in the pulmonea, is carried on by means of a vascular net work that lines the bottom of the respiratory cavity. This cavity occupies the last whorl of the shell and opens externally by a great slit, situate betwixt the body and the edge of the mantle: in most instances it lodges branchiæ (*fig.* 32 *b.*) which are composed of small leaves or fringes arranged parallelly and attached to its superior parietes upon one, two, or three lines according to the genus. All these mollusks have two tentacles (*ta*)and two eyes sometimes borne on particular peduncles; the mouth is in the form of a tube or trunk (*t*), and encloses a tongue armed with small hooks; the males have on the right side of the neck, an appendage, sometimes very thick, which cannot, in general, be drawn into the body of the animal, but is folded into the branchial cavity; the rectum and the oviduct (*ov*) are also found on the right side of this cavity, and near them we remark a particular organ, enclosing a very viscid humor, designed to form a common envelope around the eggs.

27. This order is divided into three families. In the two first (that of the trochoides and of the capuloides), there is no syphon by the aid of which, the animal can breathe without leaving its shell (*fig.* 33), while in the third family, (that of the buccinoides), there is a respiratory tube, formed by a prolongation of the edge of the pulmonary cavity of the left side, which passes through a corresponding canal or notch in the shell (*fig.* 34).

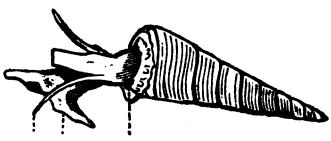


Fig. 33.—TURRITELLA.

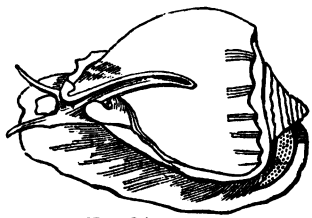


Fig. 34.—CASSIS.

27. How is the Order of Pectinibranch ga'steropods divided? How does the family of buccinoides differ from the other two families—the trochoides and capuloides?

28. The Family of TROCHOIDES are distinguished from other pectinibranch gasteropods without a syphon, by the form of their shell, which is spiral, with an entire aperture, and by the existence of an operculum, or some organ in the place of it. This family is divided into three tribes, which are distinguished by the form of the opening of the shell, namely; *Trochus*, in which this opening, angular at its external edge, is nearly quadrangular, and, as regards the axis of the shell, lies in an oblique plane, (*Figs.* 35 *and* 36); the tribe *Turbo*, in which the mouth of the shell is perfectly round (*Figs.* 43, 45, *and* 46,) and the tribe of *Hemicyclostoma*, in which this opening is more or less in the form of a crescent, as in the *Helices*, (*Figs.* 26 *and* 27.)

29. The TROCHUS, so called from the general form of the shell (that of a top,) the spire of which, more or less raised, terminates in a point, and the circumference of which is trenchant or carinate, are mollusks with a short foot, the mantle ordinarily furnished on the edge with two or three pairs of filiform appendages, the two eyes being placed on a swelling at the base of the tentacles, the mouth armed with a sort of

Fig. 35. TROCHUS NILOTICUS. *Fig.* 36.

spirally rolled tongue, and the anus opens on the right side of the respiratory cavity, which encloses two unequal branchiæ. The operculum is horny, and marked by numerous spiral turns. The tribe of trochus is divided into several little groups, according to the absence or presence of an umbilicus and some other not very important characters. Figure 35 gives a view of the base of the *Trochus niloticus*, showing the umbilicus or hole in the base of the columella (*u*), while Figure 36 is another view of the same shell. The *Solarium* is a trochus in which the

28. What are the peculiarities of the family of Trochoides? (pronounced *tro-koi-des.*) Into how many tribes is this family divided?

29. What are the characters of the tribe of Trochus? (pronounced *tro-kus.*)

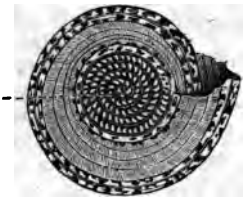


Fig. 37. SOLARIUM PERSPECTIVUM. *Fig.* 38.

shell is conical in form, (*fig.* 37) with a quadrangular aperture, and an extremely flaring umbilicus, (*fig.* 38, *u*); the anterior edges of all the involutions or whorls of the spire are marked by a crenulated cord, that is, notched on the edge, (*fig.* 38.)

Fig. 39.—TROCHUS AGGLUTINANS.

30. Among the TROCHI properly so called, with an umbilicated shell, we will mention the *Trochus agglutinans*, which is found in the West Indies and Pacific. It has the singular faculty of glueing to itself moveable bodies found on the ground on which it rests; sometimes it glues stones and sometimes shells or pieces of shells, according to the place where it is found. From this habit of building out its habitation from materials not its own, it is sometimes called the *Mason*, (*Fig.* 39.)

Fig. 40.—TROCHUS TELESCOPIUM.

There are some without an umbilicus, very conical, and very tall, that are marked by numerous whorls in the spire, with crossing striæ; the extremity of the columella is much twisted, and projects beyond the origin of the lip. A specimen of this variety is seen in the annexed figure of the *telescope trochus*,—(*Fig.* 40.)

30. What are the peculiarities of the trochus agglutinans?

Another variety is remarkable for a deep excavation at the base of the columella, resembling an umbilicus, and a projection of the circumference, as is seen in the figure of the *concave trochus*, (*fig.* 41.) which inhabits the Indian Seas, and is considered rare.

Fig. 41.—TROCHUS CONCAVUS.

There are other species, without an umbilicus, conical with a very oblique base; the aperture large, slightly angular: the columella twisted, and forming a kind of tooth at its termination. Such is the *rain-bow trochus*, (*fig.* 42.) the nacre of which is a beautiful, golden green, with very brilliant reflections of red,

Fig. 42. TROCHUS IRIS.

31. The tribe of TURBO comprises all the pectinibranch gasteropods which have a completely and regularly turbinated shell, terminated by an entirely round aperture. In it we range the turbo properly so called, delphinula, turritella, scalaria, cyclostoma, valvata, &c, (*fig.* 43)

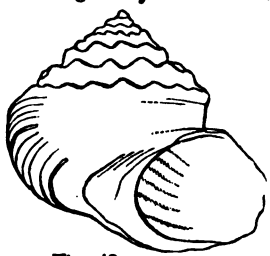


Fig. 43.—TURBO.

32. The TURBOS properly so called are recognised by their round or oval thick shell, in which the aperture is completed within, by the whorl of the spire next to the last. These mollusks have two long tentacles which, at their base, externally, support the pedunculated eyes; on the sides of the foot we remark membranous wings, sometimes simple, sometimes fringed or furnished with one or two filaments; and their operculum is sometimes horny, at others calcareous, or extremely thick. Among the varieties of this genus is the *Turbo Pica*, (*fig.* 44.) which inhabits the

Fig. 44.—TURBO PICA.

31. What are the characters of the tribe of Turbo? (Turbo is a Latin word, meaning a whirling or twisting.)

32. What are the characters of the Turbo properly so called?

equatorial regions of the atlantic ocean. It is a common, heavy shell; it has a horny operculum, and is remarkable for a tooth situate at the orifice of the umbilicus.

33. The DELPHINULA has a thick shell like the last, but rolled almost in the same plane, and the aperture is entirely formed by the last whorl of the spire, (*fig.* 45) the most common species is remarkable for its twisted and branching spines.

Fig. 45.—DELPHINULA.

34. The TURRITELLA and Scalaria have a very elongated spire: in the first (*fig.* 33, *page* 48) the mouth or aperture of the shell is formed as in the turbo, properly so called, and in the last, it is similar to that of the Delphinula. The Wentletrap or precious scalaria, (*fig.* 46.) has the volutions connected by longitudinal ribs.

Fig. 46.—SCALARIA.

35. The CYCLOSTOMÆ, which are distinguished by the absence of branchiæ, and by their aërial respiration, also have a shell with a round mouth, closed by a thin circular operculum (*fig.* 47, *o*); it is in form of an oval spire and finely striated transversely. These animals live in woods, under moss and stones.

Fig. 47.
CYCLOSTOMA.

36. Finally the fresh water molluscks, named VALVATA, in which the shell somewhat resembles that of the planorbis, but has a circular aperture, furnished with an operculum, also take their place here. One species which inhabits stagnant waters in France has been called the *feather bearer*, from the manner in which the branchia, which is in form of a feather, is protruded and floats on the surface of the water when the animal wishes to breathe.

Fig. 48.
VALVATA.

33. What are the characters of the Delphinu'la?
34. What are the characters of Turrite'lla and Scala'ria?
35. What are the characters of the Cyclosto'mæ? (Cyclosto'ma: from the Greek, *kuklos*, round, and *stoma*, mouth,—*round-mouth.*)
36. What animals belong to the genus Valva'ta? (Valva'ta, Latin, formed from *valvæ*, folding doors.)

37. The Tribe of HEMICYCLOSTOMA is composed of pectinibranch gasteropods, which resemble snails in the form of their shell, of which the whorl next to the last presents a sunken arch, which gives its aperture more or less resemblance to a cresent. They form many genera, among which we will mention the *paludina, littorina, monodonta, janthina,* and *nerita.*

38. The PALUDINÆ, were, for a long time, confounded with the cyclostomæ, but the aperture of their shell is without the rolled lip, and they are provided with branchiæ for breathing in water; they show the first vestiges of the syphon, which always exists in the following family; we observe on each side of the body a sort of membranous wing, and on the right side, this prolongation curves into a small canal through which water is introduced into the branchial cavity. Many species are found in fresh waters in the United States. A common species, the *Paludina vivi'para,* so called because its young are born alive, is marked by purplish longitudinal bands, and the shell is greenish; it abounds in the standing waters of France.

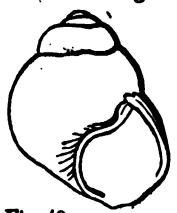


Fig. 49.—PALUDINA.

39. The LITTORINÆ do not differ much from the Paludinæ, except that they have a thicker shell, and inhabit the sea. The *Vigneau,* or *Turbo littorous,* the shell of which is round, of a brown colour, streaked with black, belongs to this genus: it abounds on the coast of France where it is eaten.

Fig. 50. LITTORINA VIGNEAU

40. The MONODONS are distinguished from the littorinæ by the presence of a blunt, slightly projecting tooth at the base of the columella. The animal generally bears on each side three or four filaments, as long as the tentacles, and has the eyes supported on peculiar pedicles. A small species, the *Trochus tesselatus* with a brown shell, spotted whitish, abounds on the coasts of France.

37. What is the characteristic of the tribe of Hemicyclosto'ma?

38. What are the characters of the genus Paludi'na? (Paludi'na, formed from the Latin *palus,* a marsh.)

39. What are the characters of the genus Littorina?

40. What are the characters of the genus Monodon?

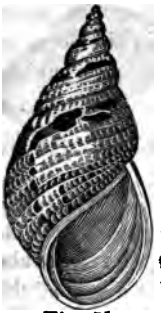


Fig. 51. PHASIANELLA PICTA.

41. The PHASIANELLA (*fig.* 51) have an oblong or pointed shell; the aperture is higher than it is wide and furnished with a strong operculum; the base of the columella is flattened, but there is no umbilicus. These animals inhabit the Indian Ocean, and their shells are much sought after by collectors, on account of the beauty of their colours

42. The shell of the AMPULLARIA (*fig.* 52), is round, ventricose, with a short spire, as in most of the Helices; the aperture is higher than it is wide, and provided with an operculum; the columella is umbilicated. The Ampullariæ, inhabit the fresh or brackish waters of hot countries. Many species are found in the United States.

Fig. 52.—AMPULLARIA.

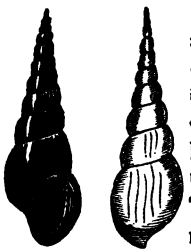


Fig. 53.—MELANIA.

43. The shell of the MELANIA (*fig.* 53) has the aperture higher than wide, and it enlarges opposite to the spire; the columella has neither plicæ (folds,) nor umbilicus; the length of the spire is very various. The animal has long tentacles, the eyes being at about one third of their length, on the external side. The melaniæ inhabit fresh water rivers; a number of species is met with in the United States.

44. The JANTHINÆ (*fig.* 54,) resemble snails in the general form of their shell, but differ considerably from the different mol-

41. How is the genus Phasiane'lla characterised? (Phasiane'lla, from the Greek, *Phasianos*, a pheasant, because this shell bears some resemblance to the pheasant in its colours.)

42. How is the genus Ampulla'ria recognised?

43. What are the characters of the genus Mela'nia? (Mela'nia, from the Greek, *melas*, black.)

44. What are the characters of the genus Janthi'na? (Janthina, from the Greek *ianthon*, violet colour.)

lusks we have described, in the formof the animal. It has no operculum, but carries on its foot a substantial, vesicular organ which resembles froth bubbles, which hinders it from crawling, but enables it to float on the surface of the water. Its head is in the form of a trunk, and has a forked tentacle on each side. The common species,—*Janthina fragilis*,—with a very thin, violet coloured shell, is very common in the Mediterranean, and the seas of all warm regions. Great numbers of them are frequently met with in perfectly calm weather floating on the surface of the ocean. When the animal is touched, it ejects a deep violet coloured liquor which dies the water all round it. The vesicular or froth-like buoy is about three times the size of the animal; it is in form of a cone, projecting from one side.

Fig. 54.—JANTHINA.

45. The NERITÆ are distinguished by the columella being a straight line, which makes the aperture of the shell, either semi-circular, or semi-elliptical. They are divided into *Natica*, in which the shell is umbilicate, (*fig.* 20, *page* 38,) and the operculum horny; into *Nerita properly so called*, in which the shell is not umbilicate, thick, (*fig.* 55.) and the operculum stony, and into *Neritina*, in which the shell is also without an umbilicus, very thin, and the operculum is horny. The last live in fresh waters.

Fig. 55.
NERITA PELORONTA.
Bleeding Tooth.

45. How is the genus Neri'ta distinguished?

LESSON IV.

FAMILY OF BUCCINOIDES.—*Buccinum—Buccinum properly so called—Harpa—Purpura—Cassis—Cerithium—Murex—Strombus—Voluta—Ovula—Cypræa—Conus.*
FAMILY OF PECTINIBRANCHIATA CAPULOIDA—*Pileopsis—Hipponyx—Crepidula—Calyptræa—Siphonaria—Sigaretus.*
ORDER OF GASTEROPODA TUBULIBRANCHIATA.
ORDER OF GASTEROPODA SCUTIBRANCHIATA.—*Haliotis—Fissurella—Emarginula.*
ORDER OF GASTEROPODA CYCLOBRANCHIATA.—*Patella—Chiton.*
ORDER OF GASTEROPODA INFEROBRANCHIATA.
ORDER OF GASTEROPODA TECTIBRANCHIATA.—*Pleurobranchus—Aplysia—Dolabella—Bullea—Bulla.*
ORDER OF GASTEROPODA NUDIBRANCHIATA.—*Eolidia—Glaucus.*
ORDER OF GASTEROPODA HETEROPODA.—*Carinaria.*
CLASS OF MOLLUSCA PTEROPODA.—*Clio borealis.*

1. In the FAMILY OF BUCCINOIDES, the shell is spiral, and in its aperture, near the extremity of the columella, there is a canal or notch, serving for the passage of the siphon or respiratory tube (*fig.* 56.) which is formed by a fold of the mantle and destined to afford the animal the power of breathing, without going out of its shell. This family is divided into three tribes, namely: Buccinum, Murex, and Angiostoma.

2. The TRIBE OF BUCCINUM comprises all the buccinoides in which the shell is without a plica (fold) in its columella, but is furnished with a notch or short canal inflected towards the left, and its aperture is very large. The foot of these mollusks is generally of moderate length, and rounded in front (*fig.* 33 *and* 34). The mantle is unprovided with fringe and is prolonged anteriorly into a long canal, which

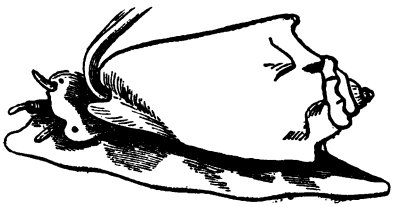


Fig. 56.—VOLUTA.

1. What are the characters of the shell in the family of Buccinoides? Into how many tribes is this family divided?
2. How is the tribe of Buc'cinum characterised? (Buc'cinum, Latin, a trumpet.)

is always uncovered. The mouth is armed with a trunk, and there is generally a small horny operculum.

3. The BUCCINUM PROPERLY SO CALLED, (*fig.* 57), has an oval, elongated shell, the aperture of which is oval, notched, and without a canal. The operculum is complete, and these animals have no veil on the head like the cerita. A great many species are known. Lamarck describes fifty-eight species.

Fig. 57. BUCCINUM UNDATUM.

Fig. 58. NASSA.

4. We give the name of NASSA to mollusks that differ very little from the preceding, but in which the columella of the shell, in place of being convex and naked, is covered by a plate of greater or less thickness (*fig.* 58,) *Dolium* also belongs to this tribe, and is remarkable for the length of its trunk and the size of its foot. It is without operculum, and the shell is recognised by being almost globose, very ventricose and furnished with projecting ribs, which follow the direction of the whorls of the spire, and make the margin of the aperture undulated (*fig.* 59). A very large species is found in the Mediterranean.

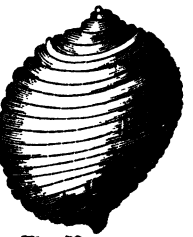


Fig. 59.—DOLIUM GALEA.

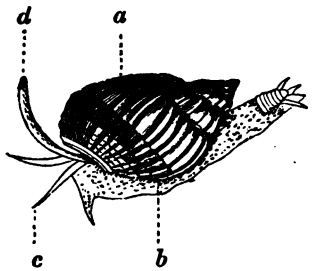


Fig. 60.—HARPA.

5. The HARPS,—*Harpa*,—have a more oval shell, furnished with projecting ribs parallel with the margin of the aperture, and differ from the preceding in the form of their foot, (*Fig.* 60.)

6. The PURPURA is furnished with an operculum, like the buccinum properly so called, which it very much

Explanation of Fig. 60.—Harp:—*a.* the shell;—*b.* the foot of the animal;—*c.* the tentacles;—*d.* the syphon.

3. What are the characters of the buccinum properly so called?

4. What are the characters of the genus Nassa? (Nassa. Latin. A net.) What are the characters of Do'lium? (Do'lium. Latin. A tub, a tun.)

5. How is the Harp characterised?

6. What are the characters of the genus Pur'pura? (Pur'pura. Latin. purple.)

resembles. The shell is ovate, thick, most frequently tuberculated, and characterised by its flattened columella, which is trenchant towards the end opposite to the spire, and forming, at that point with the external margin of the aperture, an unprojecting canal.

Fig. 61.

CASSIS. *Fig.* 62.

7. The HELMET,—CASSIS (*figs.* 34, 61, 62,) also very much resembles the ordinary buccinum; but their shell, which is ovate with a short, slightly projecting spire, is furnished with a transversely wrinkled plate, covering the columella, like the Nassa. The aperture sometimes oblong, sometimes straight, is also wrinkled externally, and its notch terminates in a little short canal which is curved backwards.

Fig. 63.
CERITHIUM ALUCO.

6. The TEREBRA differs still less from the buccinum properly so called: it is distinguished from it only by the elongation of its spire.

9. The CERITHIUM, (*fig.* 63) the shell of which is turretted, like that of the *terebra*, but furnished with a short canal curved to the left or backwards, also differs from other buccina by having a veil above the head: this animal has but a single branchia. Some of the mollusks of this genus inhabit the sea, and others fresh water. A great many living species are known; but they were formerly more abun-

7. What are the characters of the genus cassis? (Cassis. Latin. A helmet.)
8. How is Terebra distinguished from Buccinum? (Buccinum. Latin. a trumpet, a shell fish.)
9. What are the characters of Cerithium?

dant than in our day; for, in certain formations, such as the calcareous tertiary of the environs of Paris, an immense number is found in the fossil state.

10. In the TRIBE OF MUREX, the aperture of the shell is always prolonged into a canal, either straight or inflected (*fig.* 64). The animals themselves very closely resemble those of the tribe of buccinum; they have a trunk, no veil on the head, the right edge of the mantle furnished with lobes or filaments, and a horny operculum. They are all carnivorous and inhabit the sea. They are subdivided, according to the form of the shell, into *murex properly so called, fusus, strombus*, &c.

Fig. 64.—MUREX.

11. The murices properly so called are distinguished by their shell, the canal of which is projecting and straight, and the whorls are furnished with transverse elevations, in form of varices or ridges, which often present spines, or ramified and slashed plates, or lamellæ.

12. The FUSUS has a canal formed like the common murex; but the shell is without varices, that is, longitudinal ribs.

Fig. 65. STROMBUS.

13. The STROMBUS has a shell in which the canal is straight or curved to the right, and its external edge expands with age, and this canal presents a sinus (hollow) behind, in which the head lodges, when the animal extends itself. In the STROMBUS PROPERLY SO CALLED, the sort of wing formed by this prolongation of the margin of the shell is entire, (*Fig.* 65.) while, in the PTEROCERA, it is divided in the adult, into long and slender digitations. All

10. How is the tribe of Mu'rex characterised? (Mu'rex. Latin. A shell-fish.)

11. How are Mu'rices properly so called distinguished?

12. What are the characters of Fusus? (Fusus. Latin. A spindle.)

13. What are the distinguishing characters of Strom'bus? (Strom'bus. Latin. Name of a shell-fish.)

have the aperture of the shell very narrow, (*fig.* 66.) a disposition approaching to the characteristic of the following tribe.

Fig. 66. STROMBUS TRICORNIS.

14. In the TRIBE OF ANGIOSTOMA, the aperture is generally so narrow, that to enter it, the foot of the animal is obliged to be doubled.

Fig. 67. OLIVA.

In some, designated under the common name of VOLUTES,—*Voluta*,—the aperture, which is of various forms, is terminated by a notch without a canal, and the columella is marked by oblique, projecting plicæ (folds,) (*fig.* 67.): they are subdivided into VOLUTES PROPER, (*fig.* 56, *page* 56.) in which the aperture is wide, and the columella is marked by some large plicæ, and the last whorl of the spire is sometimes ventricose, sometimes conical; in the MITRA the spire is in general pointed and elongated, and in OLIVA, so called from the oblong or ellipsoid form of the shell, the aperture is long, narrow, and notched opposite to the spire, and the columella is marked by numerous plicæ, (*fig.* 67.)

16. In others, the shell is oval, the spire is concealed, and the aperture which is long and narrow, has no plicæ on the side of the columella, but presents a notch or canal at its two extremities; these are the OVULÆ. (*Fig.* 68.)

Fig. 68.—OVULA VOLVA.

17. In others again, the CYPRÆÆ (PORCELANA,) the shell, which is protuberant in the middle, and almost as much con-

14. What is the peculiarity of the tribe of Angio'stoma? (Angio'stoma, Greek, *aggeion*, a vessel, and *stoma*, mouth.)

15. What are the characters of Volu'ta? (Voluta. Latin. A wreath.) What is the character of Oli'va? (Oliva. Latin. An olive.)

16. What are the characters of the genus O'vula? (O'vula, from the Latin, *ovum*, an egg.)

17. What are the characters of the genus Cypræ'a? (Cypræa. Latin. A cowry.)

tracted at the two extremities, has a very narrow aperture, transversely wrinkled on both sides; when the animal expands itself, the mantle extends over the shell and envelopes it entirely (*fig.* 69), which, in the progress of time, produces considerable modification in the colours of the latter; for, at a certain period, it deposits new layers of calcareous matter, not only around the aperture, but also upon the whole external surface of this solid envelope.

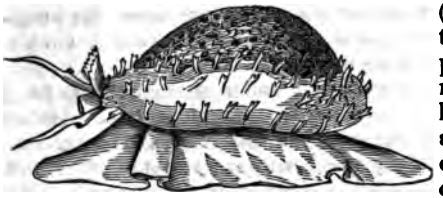


Fig. 69.—CYPRÆA.

18. Also to this tribe of mollusks belongs the genus CONUS (*fig.* 70.), which differs from all the preceding in the conical form of the shell, which gives the genus its name: a slightly or not at all projecting spire forms the base of this cone, and the aperture, which is nearly straight, extends from one end of the shell to the other.

Fig. 70. CONUS.

19. A great number of the shells, the principal characters of which we have briefly noted, are remarkable for the elegance of their form and the beauty of their colours; the cones, the porcelain shells (cyprææ), the volutes, and the olives especially, are much admired for the brilliance of their markings. Many other mollusks of the family of buccinoides are also worthy of attention on account of the viscid liquid, secreted by the gland placed, as we have already seen, in the snails, betwixt the heart and rectum. And in a considerable number of these animals, this humor has the property of changing colour when exposed to the action of air and light, and thus passes from greenish yellow to purple; spread upon stuffs, it imparts to them this rich shade, and appears to be the material employed by the ancients for producing their beautiful purple dyes. Pliny relates that on the shores of Tyre, and many other points along the coasts of the Mediterranean, there are found two genera of shells, called *buccinum* and *purpura*, both of which furnished dye for the colours termed purple and conchilian. The first of these mollusks appears to be the *Buccinum lapillus*, and

18. What are the characters of the genus Co'nus? (Co'nus. Latin. A cone.)

19. What animals are supposed to yield the purple dye which was celebrated among the ancients?

the second the *Murex brandaris* (*fig.* 64); but the quantity of colouring matter these animals yield is so small, it is difficult to explain how they could furnish so active a trade, and it must have been that the ancients used for the same purposes, the purple liquid secreted by larger and more common mollusks, such as the *aplysiæ*, which we have yet to mention.

20. The FAMILY OF PECTINIBRANCH CAPULOIDES is recognised by the shell being widely open, slightly turbinated, and without either notch, syphon or operculum. The conformation of the animal differs but little from that of other mollusks of the same order; there is only a single branchia, often with very long filaments, attached transversely to the arch of the respiratory cavity.

In this division are aranged the genera of *Pileopsis, Hipponyx, Crepidula, Calyptræa, Sigaretus &c.*

21. Animals of the genus *Pileopsis* or *capulus*, (*fig.* 71.) have their branchiæ on the anterior edge of the respiratory cavity; the shell is conical, and presents at its summit the commencement of a spire; their neck is covered by a membranous plaited veil, and they have two conical tentacles, and a tolerably long trunk or proboscis. They inhabit the sea shores of warm countries.

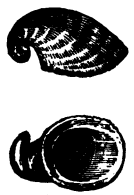


Fig. 71. CAPULUS INTORTA.

22. The genus of *Hipponyx* (*fig.* 72) consists of fossil shells, which closely resemble the preceding, but are very remarkable for a support formed by calcareous layers, upon which they rest, and which seem to have been secreted by the foot of the animal.

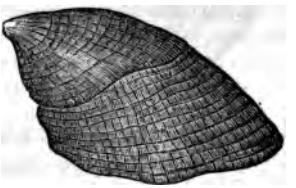


Fig. 72.—HIPPONYX.

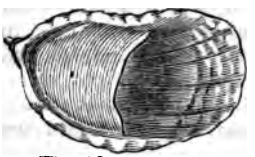


Fig. 73.—CREPIDULA.

23. The *Crepidulæ* have an oval shell, the whole base of which is half closed by a horizontal plate, which supports the abdominal sac above it, and is covered beneath by the foot, (*fig.* 73.)

20. How is the family of Pectinibranch Capuloi'des distinguished? (Capuloi'des, from the Latin, *capulus*, a hilt or handle, and the Greek, *eidos*, resemblance.)

21. What are the characters of the genus Ca'pulus? (Ca'pulus. Latin. A hilt.)

22. What are the characters of the genus Hipponyx? (Hippony'x, from the Greek, *ippos*, a horse, and *onux*, nail; horse nail, or hoof)

23. What are the characters of the genus Crepi'dula? (Crepi'dula. Latin. A slipper.)

24. The *Calyptrææ* have in the interior of the shell, in form of a hollow cone, a small plate projecting downwards, which seems to be the commencement of a columella, and is embraced in a fold of the abdominal sack; their branchiæ are composed of long slender filaments like hairs. In some of them the plate or lamina adheres to the bottom of the cone, being itself bent into a portion of a cone or of a tube, and descending vertically.

Fig. 74. CALYPTRÆA.

25. The *Siphonaria* deserve notice, because they show how much the organization of mollusks may vary without any very striking difference in the form of their shell. Until recently these animals have been ranged with the patellæ, to be described in the sequel, which they resemble in their shell, but differ from them very much in the structure of their most important organs; their branchia is composed of a few leaflets transversely attached to the bottom of a respiratory cavity, which is on the back, and communicating externally by a lateral hole in the mantle; they do not appear to possess tentacles but have a narrow veil on the head.

Fig. 75.—SIGARETUS.

26. The genus *Sigaretus* (*fig.* 75) has a flattened shell, with a slight spire, and a very large aperture, which is concealed in the mantle.

ORDER OF GASTEROPODA TUBULIBRANCHIATA.

27. Tubulibranch gasteropods are very analogous to the Pectinibranch gasteropods, but are distinguished from them by very important differences in the organization of some of their organs, and in the structure of their shell, which is fixed to submarine bodies, and is in the form of a more or less irregular tube, the commencement of which only is spiral. It is divided into the genera *Vermetus*, *Magilus*, and *Siliquaria*.

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24. What are the characters of the genus Calyptræ'a? (Calyptræ'a from the Greek, *kaluptra*, a hood.)

25. What are the characters of the genus Siphona'ria?

26. What are the characters of the genus Sigare'tus?

27. How are the Tubu'libranch distinguished from the pecti'nibranch gasteropods? (Tubu'libranch. From the Latin, *tubulus*, a little tube, and *branchiæ*, gills.)

ORDER OF GASTEROPODA SCUTIBRANCHIATA.

28. In the general form of their body and the position of their branchiæ, the scutibranch resemble the pectinibranch gasteropods; but they differ from the latter in their anatomical and physiological characters. Their shell is very open, slightly or not at all turbinated, and, like a shield, it covers the branchiæ or even the whole body. A peculiarity of their internal organization approximates them to the acephalous mollusks; their heart is traversed by the rectum and receives the blood by two auricles. They are not numerous, and are divided into *Haliotis*, *Fissurella*, &c.

29. The *Haliotides* (*fig.* 76) have a slightly turbinated shell, with a spire so small that it is only seen from the inside: it is flattened and the aperture is very large. In the *Haliotides properly so called*, there is along the columella a series of holes, through which the water reaches a slit on the right side of the mantle, and penetrates to the branchial cavity; the filiform appendages of the edge of the mantle can be protruded through these holes, and all around the foot there is a double membrane cut in fringes and furnished with long filaments. On the outside of the tentacles we find two cylindrical pedicles, bearing the eyes; and the mouth is armed with a trunk or proboscis. The external surface of the shells of these mollusks are not remarkable; but internally they are covered by a layer of nacre, of the richest and most beautifully iridescent colours. They are found in great numbers on the rocky shores of California.

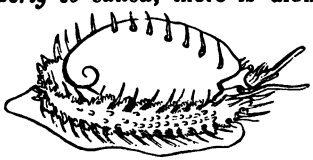

Fig. 76.—HALIOTIS.

30. The *Fissurellæ*, (*Fig.* 77), are recognised by their conical shell placed upon the middle of the back, and pierced at its summit by a small opening, which serves to give

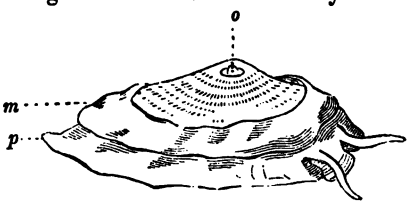

Fig. 77.—FISSURELLA.

Explanation of Fig. 77.—*p.* the foot of the animal;—*m.* the mantle;—*o.* the opening at the apex of the shell, and the anus.

28. What are the characters of the Scuti'branch ga'steropods? (Scuti'branch. From the Latin, *scutum*, a shield, and *branchiæ*, gills.)

29. What are the characters of the Halio'tides? (Halio'tides. From the Greek, *als*, the sea, and *ous*, ear; sea-ear, or *haliotis*, and *eidos*, resemblance)

30. How is the genus Fissure'lla recognised? (Fissure'lla. Latin. *Fissura*, a slit.)

passage to the air necessary for respiration, and also for the expulsion of the excrements.

31. We give the name of *Emarginula* to mollusks, very much like the fissurellæ, but their shell, in place of being open at the top, presents a slit or notch in front, communicating with the branchial cavity.

ORDER OF GASTEROPODA CYCLOBRANCHIATA.

32. The cyclobranch gasteropods closely approximate the preceding, either in their general form, or in the disposition of their internal organs; but they are distinguished by their branchiæ being fixed around the edges of the mantle, (*Fig.* 78.)

33. Some, the *Patellæ*, (*Fig.* 78.) for example, are provided with a broad-based, conical shell, which covers the whole body: they very much resemble the fissurellæ and emarginulæ, but the shell is not perforated at the apex, nor is there a notch in front as in the latter. The head is furnished with two pointed tentacles, having the eyes at their base, and a stout trunk; the anus is situate to the right, and a little above the head, and the branchiæ are composed of leaflets, or fringes, arranged in a row around the body, under the edges of the mantle. Patellæ are found in almost all parts of the world; they are found on rocks to which they adhere, and lie completely concealed beneath their shell, even after they are left by the ebbing sea.

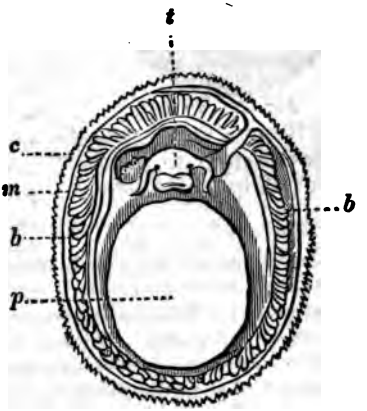

Fig. 78.—PATELLA.

Explanation of Fig. 78.—The animal of the patella seen from below;—*c.* the edge of the shell;—*p.* the foot;—*m.* the mantle:—*b.* the branchiæ;—*t.* the head.

31. How does the genus Emargi'nula differ from Fissure'lla? (Emargi'nula. From the Latin *e*, from, and *margo*, *marginis*, the margin,—from the margin—notched.)

32. How are cy'clobranch ga'steropods distinguished? (Cy'clobranch. From the Greek, *kuklos*, a wheel, and *bragchia*, gills.)

33. What are the characters of the genus Pate'lla? (Pate'lla. Latin. Knee-pan.)

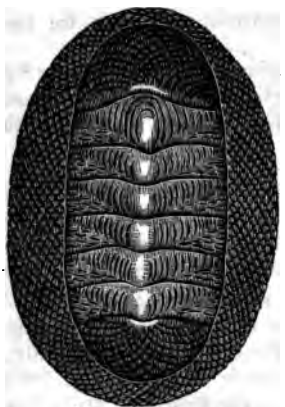

Fig. 79.—CHITON.

34. Other cyclobranch gasteropods, called *Chiton*, (*Fig.* 79,) differ from all mollusks, in the nature of their shell, which, instead of a turbinated or shield-like piece, is composed of a row of testaceous and symmetrical scales, generally eight in number, let into the mantle, and occupying the middle line of the back. The edges of this mantle, thus protected, are also very leathery, and often furnished with little scales, spines, or hairs. A membranous veil placed over the mouth takes the place of tentacles; the branchiæ are composed of lamellar pyramids, arranged on each side, beneath the edge of the mantle; the anus is at the posterior extremity of the body. Chitons most abound on the shores of tropical seas.

ORDER OF GASTEROPODA INFEROBRANCHIATA.

35. The order of Inferobranch gasteropods is composed of a very small number of naked mollusks, characterised by their branchiæ, consisting of a long series of leaflets, placed on each side of the body, between the foot, and the advanced edge of the mantle. Like the preceding, they are marine, and differ from them, not only in the absence of every vestige of shell, but also in some points of their internal anatomy, which approximate them to the gasteropods. They are divided into PHYLLIDIA, (from the Greek, *phullon*, a leaf,) in which the anus is posterior to the mantle, and the head is furnished with four tentacles; and into DIPHYLLIDIA, (from the Greek, *dis*, two, and *phullon*, leaf,) in which the anus is on the right side, and the head has a pointed tentacle, and small tubercle on each side. In all of them, the body is oval, or more or less tuberculous.

ORDER OF GASTEROPODA TECTIBRANCHIATA.

36. The Tectibranch gasteropods are, like the preceding, marine mollusks, but their branchiæ are not symmetrical; they

34. What are the characters of the genus Chi'ton? (pronounced *ky-ton.*) (Chi'ton. Greek. A garment.)

35. How are the In'ferobranch gasteropods characterised? (In'ferobranch. From the Latin, *inferus*, below, and *branchiæ*, gills.)

36. What are the characters of the tec'tibranch gasteropods? (Tec'tibranch. From the Latin *tego*, I cover, and *branchiæ*, gills.)

are composed of leaflets, more or less divided, attached along the right side, (*Fig.* 80, *br*) or on the back, (*Fig.* 81.) and more or less covered by the mantle, which almost always encloses a small shell in its thickness. Their form is very variable. They are divided into *Pleurobranchus, Pleurobranchides, Aplysia, Dolabella, Akera, &c.*

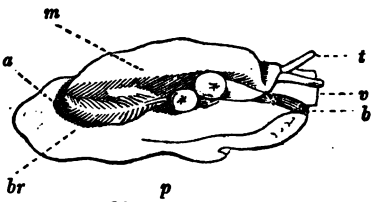

Fig. 80.—PLEUROBRANCHUS.

37. The PLEUROBRANCHI, are mollusks of an oval form; in which the branchiæ are fixed on the right side, between the mantle and foot, (*Fig*, 80.) The mouth is in the form of a proboscis or trunk, and is surmounted by a small triangular veil, and two tentacles; they have four stomachs, the second one of which is sometimes armed with bony pieces, and the anus opens behind the branchiæ. One species, of a lemon yellow colour is found on the coasts of France.

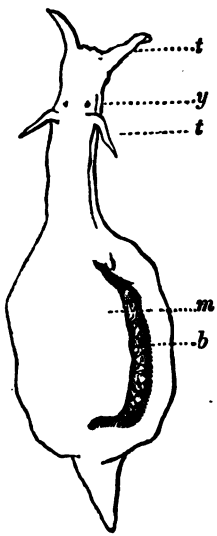

Fig. 81.—APLYSIA.

38. The APLYSIÆ, which the ancients called sea-hares, have a very singular form; the body resembles that of a sort of limax; but the edges of the foot, erected in flexible crests, surround the back and may be even reflected over it. Their head is supported by a neck of greater or less length, and furnished with four tentacles, (*Fig.* 81, *t.*) the two upper ones being hollowed like the ears of a quadruped, and placed above the eyes, (*y.*) The branchiæ, in the form of very complicated

Explanation of Fig. 80.—*m.* the mantle, raised up to show the branchiæ, *br*;—*a.* the anus;—*b.* the mouth and trunk;—*v.* the veil;—*t.* the tentacles;—*p.* the foot.

Explanation of Fig. 81.—*t,t.* the tentacles;—*y.* the eyes;—*m.* the mantle;—*b.* the branchiæ.

37. What are the characters of the genus pleu'robranchus? (Pleu'robranchus. From the Greek, *pleura*, side, and *bragchia*, gills.)

38. What are the characters of the genus Aply'sia? (Aply'sia. From the Greek, *aplusia*, uncleanness)

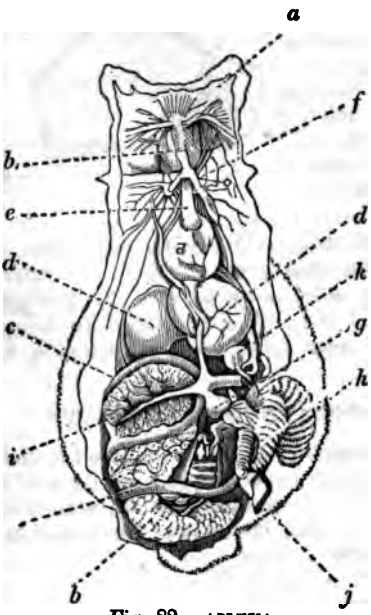

Fig. 82.—APLYSIA.

leaflets, are fixed upon the back, by means of a broad membranous pedicle, and covered by a small mantle (*m.*) in the thickness of which we find a small horny shell. And the anus is situate behind the branchiæ. These mollusks live on fucus, and are provided with an enormous crop, and three other stomachs, (*Fig.* 82, *d*,) the second and third of which are armed internally with sharp hooks, and cartilaginous plates. A particular gland secretes an acrid liquor, and pours it out through an opening situate on the right side. A purple coloured liquid exudes (sweats) from the edge of the mantle, when the animal contracts, and is sufficient in quantity to dye the water to a considerable distance around it. Several species of Aplysiæ, which vary in colour, are found on the coasts of France.

39. The *Dolabellæ* do not differ much from the Aplysiæ, except in the position of their branchiæ, and their mantle at the posterior extremity of the body. They are found in the Mediterranean as well as in the Indian seas.

40. The *Akeræ* (*fig.* 83.) also resemble the Aplysiæ in the complication and armature of the stomach, as well as in the position of their branchiæ, and several other important points of their organization; but they are distinguished by their tentacles which are short, very thick, and so arranged as to form together a

Explanation of Fig. 82.—Anatomy of the Aplysia:—*a.* the head;—*b.* the pharynx;—*c.* œsophagus;—*d.* the three stomachs;—*c.* the intestines;—*f.* the nervous collar surrounding the œsophagus;—*g.* the heart;—*h.* the branchiæ;—*i.* the liver;—*j.* the anus;—*k.* the bladder:—*l.* the ovary.

39. What is Dolabe'lla? (Dolabe'lla. Latin. A little axe or hatchet.)

40. How are Ake'ræ distinguished from the Aplysiæ? (Ake'ra. From the Greek, *a*, without, and *keras*. horn.)

large fleshy shield above the eyes (*fig.* 83, *v*). Many of these animals effuse a purple liquid. Some are entirely unprovided with shell, or have only a vestage of a shell: these are the *akeræ properly so called*; others have a shell, somewhat rolled upon itself, and without a projecting spire or notch, which is concealed in the thickness of the mantle; these form the genus *Bullæa*; and there are still others in which the shell, only covered by a slight epidermis, is more convoluted and sufficiently large to afford a retreat for the animal: these constitute the division of *Bulla*.

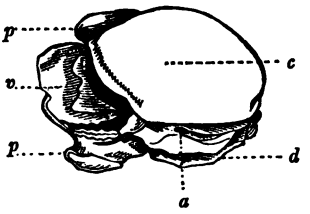

Fig. 83.—BULLA HYDATIS.

ORDER OF GASTEROPODA NUDIBRANCHIATA.

41. The mollusks composing this group are without a shell and carry their branchiæ on some part of the back (*fig.* 84). The structure of some of their internal organs approximates them to the pulmonea, the inferobranchiata, and the tectibranchiata; they all inhabit the sea.

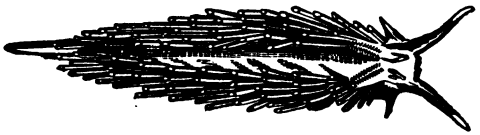

Fig. 84.—EOLIDIA.

42. Among the genera possessing this kind of organization, we will cite the *Doris*, the general form of which is nearly the same as that of the Pleurobranchus (*fig.* 83), and in which the branchiæ are inserted in a circle around the anus, at the posterior part of the back; the TRITONIA, in which the branchiæ, in form of miniature trees, are attached along the two sides of

Explanation of Fig. 83.—Animal of the *Bulla hydatis*:—*c*. the shell:—*p,p*. the two lobes of the foot;—*d*. posterior part of the foot;—*v*. the sort of veil formed by the union of the tentacles;—*a*. the anus.

41. What are the characters of the Nudibranch gasteropods? (Nudibranch. From the Latin, *nudus*, naked, and *branchiæ*, gills.)

42. What are the characters of the genus glaucus? (Glaucus. From the Greek, *glaukos*, blue.) What are the characters of the Eolidia?

the back, and in which the mouth is armed with lateral horny jaws, similar to shears; the GLAUCUS, remarkable for its blue colour (*fig.* 85), in which the branchiæ, three pairs in number, are situated in the same manner, but each one is composed of several long fringes, spread like a fan; and the EOLIDIÆ (*fig.* 84) which resemble small limaces in form, in which the branchiæ are composed of laminæ or leaflets, arranged like scales, more or less crowded together on each side of the back. They are found in every sea.

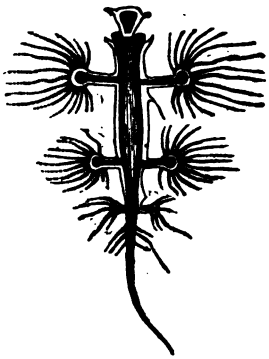

Fig. 85.—GLAUCUS.

ORDER OF GASTEROPODA HETEROPODA.

43. These gasteropods are not organised, like all the preceding for crawling on the belly, but for swimming only. In fact, their foot, in place of forming a horizontal fleshy disk, is compressed into a vertical membranous plate, which is used as a fin. Their body is formed of a transparent, gelatinous substance, and their branchiæ are placed on the posterior part of the back.

The principal genera of this group are the CARINARIA and FIOROLA.

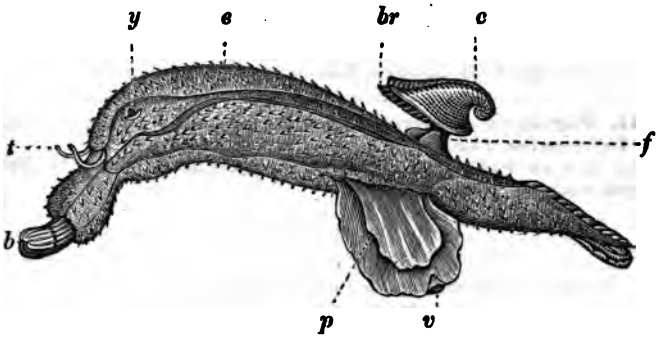

Fig. 86.—CARINARIA MEDITERRANEA.

Explanation of Fig. 86.—*b*, the mouth;—*t*. the tentacles;—*y*. the eyes;—*e*. the stomach;—*f*. the liver;—*c*. the shell;—*br*. the branchiæ;——*p*. the foot;—*v*. a small sucker situate on the side of the foot.

43. What are the characters of the Heteropo'da? (Heteropo'da. From the Greek, *eteros*, various, and *pous*, foot.)

44. The CARINARIÆ, have the abdomen (that is to say, a kind of sac enclosing the heart, the liver and some other organs), covered by a symmetrica land conical shell, the apex of which is curved backwards, and the anterior edge covers the base of the branchiæ, (*fig.* 86, *br.*) There is one species in the Mediterranean, but three have been discovered.

The FIOROLÆ, have no shell, but, in other respects, very much resemble the carinariæ.

CLASS OF MOLLUSCA PTEROPODA.

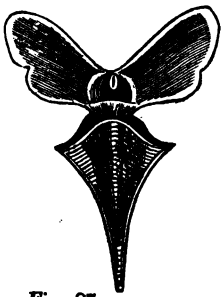

Fig. 87.—HYALEA.

45. The mollusks composing this group are organised for swimming only: they possess no organ by means of which they can crawl, or even attach themselves to sub-marine bodies, but continually float in the sea, and move by the assistance of fins, placed like wings on each side of the mouth (*fig.* 87.) They are all of small size, and most of them inhabit the seas of warm countries; but they are also found in the neighbourhood of the poles. The *Clio borealis*, for example, abounds so extensively in the arctic regions, that, in spite of their small size, (scarcely an inch long,) they become, in certain seasons, the ordinary food of whales. Their form varies much: some of them are naked; others are provided with a shell. They constitute several genera, the principal of which are the *Clio*, *Hyalea*, *Cleodora*, *Cymbulia*, &c.

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44. What are the characters of the genus Carina'ria? (Carina'ria: from the Latin, *cari'na*, a keel.)

45. How are the Pte'ropoda characterised? (Pte'ropoda: from the Greek, *pteron*, wing, and *pous*, foot.)

LESSON V.

CLASS OF MOLLUSCA ACEPHALA, or, LAMELLIBRANCHIATA—*Organization—Classification.*

FAMILY OF OSTRACEA— *Classification—Oysters— Gryphœa —Pecten—Lima—Malleus—Anomia—Spondylus—Perna— Etheria—Avicula—Pearls—Pearl fishery—Pinna—Arca— Pectunculus—Trigonia.*

FAMILY OF MYTILACEA— *Mussels* (Mytilus)— *Modiolus — Anodonta—Unio.*

FAMILY OF CHAMACEA—*Tridacna—Chama—Isocardia.*

CLASS OF MOLLUSCA LAMELLIBRANCHIATA.

1. All the mollusks we have heretofore considered have a distinct head; those we have yet to mention are without this part, and their whole organization is of the simplest kind. The mouth is always concealed at the bottom of the mantle, or between its folds: they have neither teeth nor eyes. The nervous system is very simple, and the organs of locomotion are very incomplete or lamellibranch.

2. In animals which form the class of acephalous mollusks, (called by Lamarck *Mollusca conchifera,*) the mantle is very large and folded in two, so as to enclose the body, as the leaves of a book are enclosed by its covers. Sometimes these two leaves are free at their inferior edge, sometimes united so as to constitute a tube (*fig.* 88, *ts, ti*). A shell, composed of two pieces, called valves, cover this mantle entirely or in part, and at its superior part there is a binge furnished with an elastic ligament, the play of which causes the valves to gape whenever the muscles (*ma, mp*), which extend from one valve to the other, do not contract so as to keep them shut. The branchiæ (*br*) are in form of great leaves, transversely and regularly striated; they are always four in number, and placed between the internal face of the mantle (or pallial membrane) and the body of the animal. The mouth is at one of the extremities of the body, and has on each side of it, two small triangular bodies, (*t,*) which are formed by the extremities of the lips and serve as tentacula; the stomach, liver, and other viscera, are lodged between the mouth and anus, and beneath the heart, (*co,*) which is situate on the back; and the lower part of the body

1. What is the distinguishing feature of the lamellibra'nch mollusks? (Lamellibra'nch: From the Latin, *lamella*, a thin plate, and *branchiæ*, gills.)

2. What are the general characters of acephalous mollusks? (pronounced *a-kef'-alus.* From the Greek *a*, without, and *kephale*, head.)

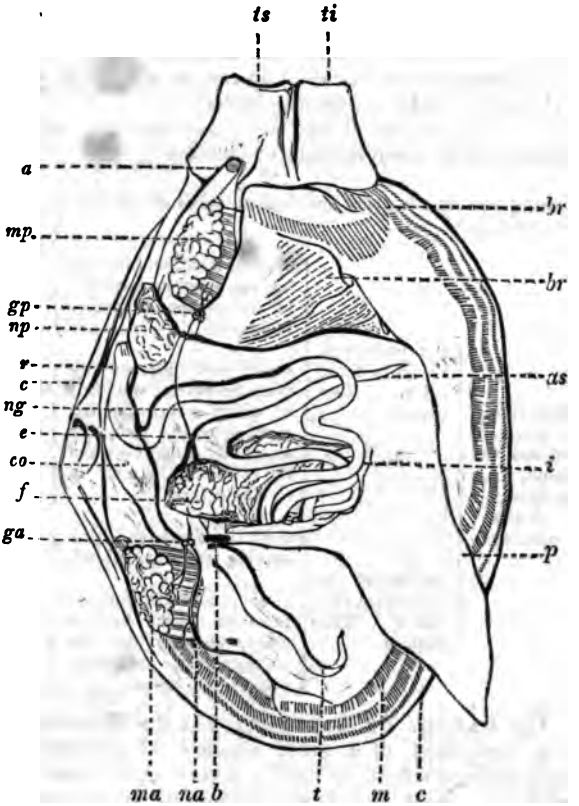


Fig. 88.—ANATOMY OF A MACTRA.

Explanation of Fig. 88.—Anatomy of a mactra: one valve of the shell, the corresponding half of the mantle and the branchiæ have been removed on the left side:—*c.* the shell;—*m.* the mantle;—*ma.* the anterior muscle;—*mp.* the posterior muscle;—*b.* the mouth;—*t.* the tentacle;—*e.* the stomach;—*as.* appendix of the stomach;—*i.* the intestines;—*f.* the liver;—*p.* the foot;—*co.* the heart traversed by the rectum, (*r.*);—*ts.* the superior tube into which the anus (*a.*) opens;—*ti.* the inferior or respiratory tube;—*br.* the branchiæ of the right side;—*ga.* the anterior ganglia;—*na.* nerves arising from them;—*ng.* inter-ganglionic nerves;—*gp.* posterior ganglia;—*np.* nerves arising from them and distributed to the mantle.

is almost always prolonged into a fleshy mass, (*p*,) called the *foot*, which serves for motion, and sometimes has at its base, a bundle of horny threads, called *byssus*, by means of which the animal fixes itself to sub-marine bodies.

3. This class is divided into five great families, which may be recognised by the following characters:

ACEPHALA.

- having the mantle open, and without tubes or particular apertures. — (Families.) OSTRACEA.
- having the mantle closed behind, so as to form particular openings.
  - not prolonged so as to form tubes. The mantle
    - open in front, and having but one separate aperture for the escape of excrement. — MYTILACEA.
    - closed and pierced by three apertures, the first of which serves for the passage of the foot, the second for respiration, and the third for the exit of excrement. — CHAMACEA.
  - prolonged so as to form two tubes. The mantle
    - open in front and presenting two tubes behind. — CARDIACEA.
    - closed, and not having, in front or below, but a single opening for the passage of the foot, and behind, two tubes. — INCLUSA.

4. The FAMILY OF OSTRACEA, has the oyster for its type, and is composed of a great number of mollusks, that are entirely without a foot, or having a very small one only, and, which for the most part, live attached to sub-marine bodies, either by their shell or by their byssus. The mantle is open behind as well as in front, and its two lobes are no where united to form particular openings, as we have remarked in all other acephala.

5. This group is divided into two tribes, according as there is a single muscle, going from one valve to the other, or two

3. Into how many families is the class of lamellibranch mollusks divided?

4. What are the characters of the family of Ostra'cea? (From the Latin, *ostrea*, an oyster.)

5. What is the distinguishing character of the tribe of Mono'mya'ria? (Mono'mya'ria. From the Greek, *monos*, single, and *muôn*, muscle.) How is the tribe of Di'mya'ria distinguished? (Di'mya'ria. From the Greek, *dis*, two, and *muôn*, muscle.)

of these organs, one placed near the anus and the other in front of the mouth, an arrangement which exists in nearly all other acephala. The first tribe, in which there is but one muscle, is called *Monomyaria*, and the second *Dimyaria*.

6. To the first of these divisions belong the OYSTERS,—*Ostrea*. The shell of these mollusks is irregular, laminated, and composed of two unequal valves, united by a short ligament lodged at either extremity in a pit, and the hinge is without teeth or projecting laminæ. The structure of the animal

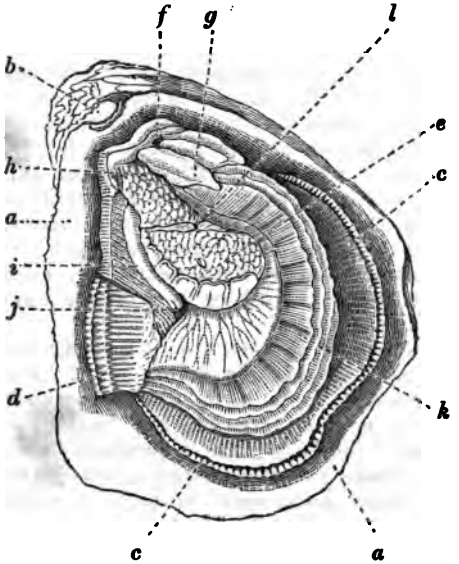


Fig. 89.—ANATOMY OF AN OYSTER.

itself is very simple. Its mantle, the lobes of which are united above near the hinge (*b*), has a double fringed border: there is no appearance of foot. The adductor muscle (*e*) of the valves (commonly called the heart) is situate near the centre of the body, and the heart (*l*), instead of being placed as usual on the

Explanation of Fig. 89.—Anatomy of an oyster:—*a*. one of the valves of the shell;—*b*. the hinge;—*c*. mantle of the left side;—*d*. portion of the right lobe of the mantle;—*e*. the muscle;—*f*. the mouth;—*g*. the labial tentacula;—*h*. the liver;—*i*. the intestine;—*j*. the anus;—*k*. the branchiæ;—*l*. the heart.

6. What are the characters of the family of Ostracea? Where are oysters found?

back, is found between this muscle and the mass of the viscera, where it is readily distinguished from the brown colour of its auricle; the mouth is concealed under a sort of hood, formed by the union of the upper portion of the two lobes of the mantle; the tentacles, which surround this opening, closely resemble the branchiæ, which are large and cover the whole abdomen; and the anus is seen above the muscle. All these mollusks have an ovary and produce eggs, which, at the time of laying, are extremely small and suspended in a whitish liquid, the appearance of which is analogous to that of minute drops of tallow. This spawn floats on the water and soon adheres to neighbouring shells or some other submarine body: and the young oysters are always adherent, either to each other or to an adult oyster or to the rocks on which they live; but, in the first case, they generally detach themselves as they advance in age, and form only great masses which are called *beds* or *banks*. Their growth is very rapid. We are assured that at the end of three months after being spawned, they are of the size of a quarter of a dollar, and at the end of the first year, they are about two inches in diameter; and in three years they attain to about three inches in length. Nothing is precisely known of the duration of their existence.

7. Many species of oysters are described: the most interesting and most extensively diffused is the *Ostrea edulis*; —the edible oyster, affords us a wholesome and agreeable article of diet, and its consumption has been immense since the remotest antiquity. These mollusks are ordinarily found in great numbers together, forming beds of considerable extent, situate near sea coasts, in bays or estuaries, or in localities where the sea is not very deep. They are objects of active pursuit, and are caught by means of a kind of rake with a net attached, called a *drag*, or *dredge*, which is drawn over the oyster-bed; or where the water is shallow, they are taken up by long tongs of a suitable formation: in France, after being caught they are not immediately consumed, but are placed (planted out) in particular basins, where they are kept for a time, and where they fatten and acquire a more delicate flavor. The largest are usually taken from the shell and pickled; but the others are eaten without preparation, and are esteemed by many only while alive. In fact their preservation for any length of time is prevented by the habit these animals have of closing the shell as soon as they are taken out of the water. When dead their shell remains open.

7. How are oysters caught?

8. European oysters possess a much more decided flavor, a stronger taste, than those of the United States; Americans on first eating oysters in London or Paris, commonly complain of their strong coppery taste, and it is not until after several trials they learn to prefer them to our own. The locality of oyster beds exercises a great influence over the taste of the oyster; within the tropics they are rarely found good, and they are almost unknown in the Pacific Ocean. Oysters taken near the entrance of the Chesapeake and Delaware Bays, have a high reputation, and are consumed in great quantities. Norfolk oysters are proverbially excellent.

The markets of Paris and the north of France are chiefly supplied from the bay of Cancale; from which the boats of Houlle, near Cancale, and Granville, carry away more than eighty millions of these mollusks every year, the major part of which are sent to Courseulles and other parts of Normandy, where there are considerable establishments for the *parkage* (planting out) of oysters, whence they are sent post to Paris. About the beginning of summer these mollusks cast their spawn: at this season it is customary not to eat them, and it is generally believed they are then unwholesome, but this opinion does not appear to be well founded.

9. We give the name of GRYPHÆA to shells, which for the most part are fossil, and which are very analogous to oysters, but the convex valve is more projecting at the apex or beak, and at that point bends into a hook (*fig.* 90). They are found in very ancient formations. There is but one living species known.

Fig. 90.—GRYPHÆA.

10. The SCALLOPS,—*Pecten* (also called the pilgrim's shell from being worn as an ornament by pilgrims), resemble the oysters in the disposition of the hinge, and may be easily recognised by their inequivalve, semicircular shell, almost always marked by ribs, radiating from the apex of each valve towards their margin, and having on each side of the hinge, an

8. How do European oysters differ from those of the United States?

9. What is the character of the Gryphæa? (Gryphæ'a: from the Greek. *grupos*, incurved.)

10. What are the characters of the genus Pecten? (Pecten. Latin. A comb.) What is meant by the ear of a shell?

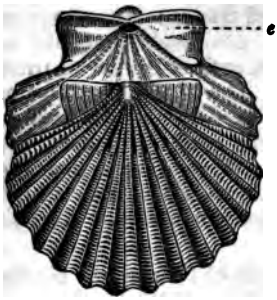


Fig. 91.—PECTEN JACOBÆUS.

angular enlargement called the *ear* (*fig.* 91 *e*). In some species there is a byssus; but most of these mollusks are not adherent, and can even swim with considerable rapidity by suddenly closing their valves. The mouth is furnished with many branched tentacula, which take the place of labial lamellæ, and between the branchiæ, there is a small oval foot. St. James' Pecten is found on the coast of France. The species of this genus are very numerous and are very generally diffused.

The following genera are also placed among the oysters; *Lima and Pedum*, the shells of which are oval or oblong and somewhat resembling the scallop in their general form:

11. The *Hammer Oysters —Malleus*, (*fig.* 92) which have a notch near the hinge for the passage of a byssus: the shell is irregular and the ears are prolonged, making its shape slightly resemble a hammer: the ANOMIÆ, in which the inferior valve is deeply *notched* (*fig.* 93) along side of the ligament, permitting the central part of the muscle to pass through it to be inserted into a plate, sometimes horny, sometimes stony, by aid of which the animal attaches itself:

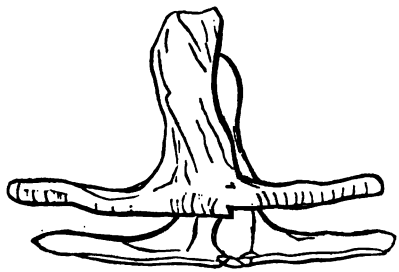


Fig. 92.—MALLEUS.

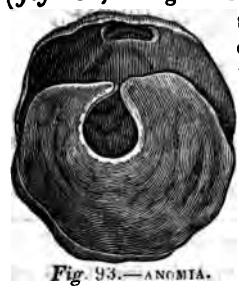


Fig. 93.—ANOMIA.

12. SPONDYLUS, in which the shell is foliated or even spiny, and on each valve at the hinge, there are two teeth which are received into pits in the opposite valve:

11. What are the characters of the genus Ma'lleus? (Ma'lleus. Latin. A hammer.) What are the characters of the genus Ano'mia? (Ano'mia. From the Greek, *a*, without, and *nomos*, law; because not easily placed according to the laws of classification.)

12. How is the genus Spo'ndylus known? (Spo'ndylus. Latin. A spindle, or shell-fish.)

13. PERNA, (*fig.* 94) in which the hinge is composed of several ligaments inserted into particular pits; besides a great many other shells, either recent or fossil.

Fig. 94.—PERNA.

Among the Ostracea provided with two distinct muscles, and the shells consequently marked, on the internal surface of each valve, by two irregular surfaces (muscular depressions) corresponding with the insertion of these organs we will mention *Etheria*, *Avicula*, *Pinna*, *Arca*, and *Trigonia*.

14. The *Etheriæ* are very analogous to oysters: their shell is large, inequivalve, very irregular, without teeth at the hinge and provided with a ligament, which is partly internal and partly external. They are very rare shells, and have been overlooked by travellers from being attached to rocks at considerable depths. They inhabit the East Indian seas.

15. The AVICULÆ are recognised by their inequivalve shell, with a rectilinear hinge furnished with a narrow ligament, and frequently elongated into wings at its two extremities (*fig.* 95), The body of these mollusks is very small and prolonged into a vermiform, and conical foot, and furnished with a byssus for the passage of which there is a notch in the side of the shell. The anterior adductor muscle is extremely small and the labial appendages very large. These mollusks have

Fig. 95.—AVICULA.

13. What is the genus Per'na? (Per'na. Latin. A gammon of bacon. A shell-fish.)

14. What are the characters of the genus Ethe'ria? (Ethe'ria. From the Greek, *aithô*, I shine.)

15. How is the Avi'cula recognised? (Avi'cula. From the Latin, *avis*, a bird; because, when the shell is widely open, it bears a remote resemblance to a bird with spread wings.) How does the genus Meleagri'na differ from Avicula? (Meleagri'na. From the Greek, *meleag'ris*, a guinea-hen.)

been divided, perhaps without sufficient reason, into two genera: AVICULA and MELEAGRINA, according as the shell is with or without the wing-like prolongations, and the hinge is armed with a tooth or unprovided with a similar protuberance; the shell of the latter is nearly equivalve, and the passage of the byssus produces in each valve, a notch. The *Meleagrinæ* are more scaly externally than the aviculæ. Their nacre is sometimes very thick and very brilliant; and the extravasation of the liquid, destined for the periodical augmentation of the interior of the shell, frequently gives rise to isolated deposits of this beautiful nacre, forming *pearls*. The shell of the Pearl Oyster, is nearly semicircular, scaly and greenish brown externally; it grows to considerable size and is to be found on the coast of Ceylon, in the Persian Gulf, the gulf of Mexico and in many other localities where it occurs in extensive beds, attached by its byssus to submarine rocks: it is the object of an active fishery.

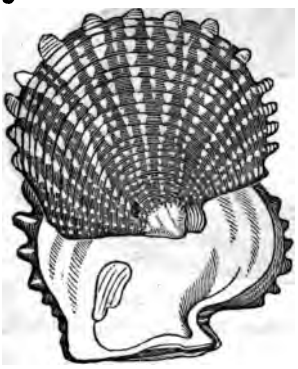


Fig. 96.—MELEAGRINA MARGARITIFERA.

16. Pearls as stated above, are bodies of the same nature as the brilliant nacre lining the shell: they are composed of concentric layers of nacre very closely applied one over the other, like the coats of an onion, and are produced whenever this matter, instead of being spread out in thin layers over those already deposited, constitutes small isolated masses like little drops, or adhering to the shell by a mere pedicle. Their formation depends upon a kind of disease or, at least, upon an anomalous activity of the secretory process which gives rise to nacre: hence every circumstance that stimulates this secretion, such as the presence of a grain of sand, or other foreign body betwixt the shell and the mantle of the animal, tends to bring about this formation. Pearl Oysters are not the only mollusks that produce pearls. All shells that are internally nacreous may contain them. Patellæ, haliotides, and our common mussels sometimes contain them, and it is not uncommon to find them in a sort of large mussel (*unio*) which inhabits the great rivers of northern Europe and the United States; but the

16. What are pearls?

Meleagrinæ furnish the greatest quantity and yield the most beautiful pearls.

17. The chief Pearl fisheries are in the gulf of Manaar on the coast of Ceylon, in the Persian gulf, the gulf of Panama, and on the coast of California; but there are banks of Meleagrinæ (pearl oysters) in many other localities, such as the coast of Japan, Cumana, &c. To obtain these precious mollusks, men accustomed to the exercise, dive to the bottom of the sea and collect them, at depths of from twenty to fifty feet. To accelerate his descent, the diver seizes a stone (weighing from 15 to 25 pounds) with his toes, and on reaching the bottom he abandons the diving stone, (which is drawn up by attendants in the boat, to be prepared to take him down again), clings to the ground, and begins to fill a net which he carries down with him for the purpose. When, from the necessity of breathing or fear of sharks, he wishes to ascend, he checks the cord of the net, which is instantly felt by the attendants, who commence pulling up as fast as they are able; the diver remains with the net until it is so far clear of the bottom as to be in no danger of upsetting, and then commences hauling himself up by the cord, (hand over hand,) which his attendants are likewise pulling; when by these measures his body has acquired an impetus upwards, he forsakes the cord and rapidly ascends to the surface, swims to his diving stone, and by the time the contents of his net have been emptied into the boat he is ready to go down again. One diver will take up in a day from one to four thousand oysters. The diver seldom exceeds a minute under water; the more common time is from 53 to 57 seconds. In order that the banks may not be devastated, they are under regulation, and it is supposed that seven years are required for the oyster to attain its full size. At Ceylon the fishing season lasts from the middle of February to the end of March.

"During this period, the shores of Arippo are enlivened by crowds of people from all parts of the country; divers, boat-owners, speculators, and the curious, assemble to behold

"Pale glistening pearls, and rainbow colored shells,"

while the lapidary attends with his wooden stand and bow, to drill the pearls and fit them to be strung, so soon as they are got out of the oyster, which, according to all accounts, is a tedious, and rather disgusting operation. The oysters are put into pens, and there left until the animal matter becomes softened by putrefaction, when it is subjected to frequent washings, and the pearls shine forth, emblems of purity in the loathsome mass. Some are of a bluish, some of a yellowish, and some of a whitish lustre; each class finds a ready market among its admirers; in the East, the bluish and yellowish varieties are most prized, but in the eyes of the christian fair, the pure white shine brightest."—*Ruschenberger's Voyage Round the World.*

17. How are pearls obtained?

The annual revenue from the pearl fishery of Ceylon, is estimated at about $80,000.

18. The PINNÆ have two equal valves in form of a half-open fan, gaping and united by a ligament along one of their sides. A very large species is found in the Mediterranean, which lives half buried in the sand, and anchored by its byssus, the filaments of which, being very strong, fine and brilliant as silk, are employed by the inhabitants of some parts of Calabria and Sicily in the manufacture of precious stuffs.

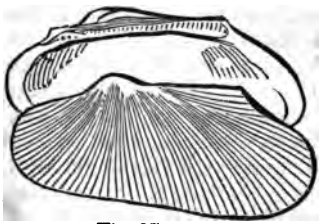


Fig. 97.—ARCA.

19. The ARCÆ are distinguished from all the preceding, by their equivalve shell, the hinge, which extends along the side of the valves, is studded with a great many little teeth, which fit into the intervals of those of the opposite side reciprocally; in some, the ARCA PROPERLY SO CALLED, (*Fig.* 97.) the hinge is rectilinear, and the shell is longer in a direction parallel to this junction; in others, named PECTUNCULUS, (*Fig.* 98.) the hinge is curved, and the shell is lenticular in form. The first are met with near the shore in rocky situations, and are ordinarily covered by a hairy epidermis; the latter live in the mud.

Fig. 98.—PECTUNCULUS.

20. Finally, the TRIGONIÆ, most of the species of which are fossil, are remarkable for their peculiar hinge; the right valve is furnished with two projecting plates, crenulate on

18. What are the characters of the genus Pi'nna? (Pi'nna. Latin. A fin.)

19. What are the characters of the genus Arca? What are the characters of the genus Pectu'nculus? (Pectu'nculus. Latin. The diminutive of *pecten*, a comb.)

20. What is Trigo'nia? (From the Greek, *trigônos*, having three corners.

each face, (*Fig.* 99.) and entering between four plates of the left (opposite) valve, likewise crenulated upon their internal face only. There is but one living species known, — *Trigonia pectinata*, which inhabits the seas of New Holland; externally, it has the aspect of pecten without ears.

Fig. 99.—TRIGONIA PECTINATA.

21. In the Family of MYTILACEA, the mantle is widely open in front, as in the ostracea, but there is a particular opening for the escape of excrement; this orifice, however, is not prolonged into a tube as in the families that follow, and there is no special aperture for the passage of water for the purpose of respiration. There is always a distinct foot, and the valves are approximated by the action of two adductor muscles.

The Mytilaceæ resemble each other sufficiently to be commonly known under the single name of Mussels, but they require, nevertheless, to be separated into several genera, the most important of which are Mussels properly so called,— *Mytilus*,—*Anodonta*, and *Unio*.

22. MUSSELS PROPERLY SO CALLED,—*Mytilus*,—abound on the rocks of the coast of France, and of other countries, where they live fixed by the byssus and generally closely united to each other. Their shell is shut, and its valves triangular in form, are equal, arched and united by a narrow ligament on the side of their acute angle. The mouth of the animal is situate near the summit of the shell, the opposite extremity of which gives passage to the byssus: the anus also is placed near the hinge; and opposite to this orifice there is a particular opening or small tube formed by the mantle; towards the round angle of the shell, where the water necessary for respiration passes, the edge of the mantle is fringed; and the foot is slender, cylindrical, and furnished behind with a silky byssus. Mussels are generally eaten as food, but they sometimes occasion a kind of poisoning, accompanied by very violent symptoms, occasionally followed by death.

21. What are the characters of the family of Mytila'cea?

22. What are the characters of the genus My'tilus? From the Greek, *mutilos*, a mussel.)

23. We distinguish those Mussels which have the hinge placed lower, under the name of MODIOLUS, and another is called LITHODOMUS, which has the shell almost equally rounded at both ends, and excavates holes in stones, to which it was at first only suspended.

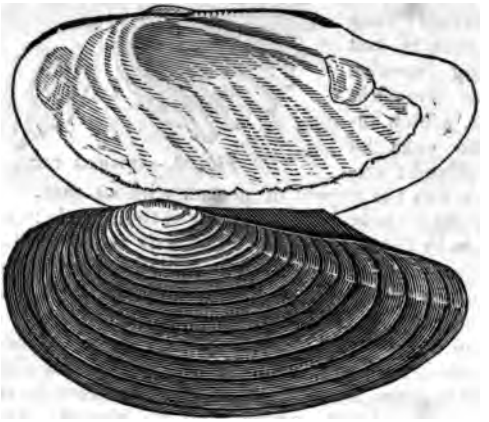


Fig. 100.—ANODONTA.

24. The ANODONTÆ live in fresh waters, and are recognised by their thin shell, moderately inflated, oval, close, and without teeth in the hinge, (*fig.* 100.); they want the byssus, and are provided with a very large foot, compressed and almost quadrangular in form, by means of whfch they crawl on the sand or mud. A great many species are found in the great rivers of the United States.

25. The UNIONES closely resemble the Anodontæ, but have a more complicated hinge, the right valve having a pit (fossette) into which a tooth of the left valve penetrates, presenting behind a long lamina which, in its turn, is received between two laminæ of the opposite side. These mollusks also inhabit fresh waters, but prefer those which are running. A very great number of species are found in our Western waters, for the description of most of which we are indebted to the labours of Mr. I. Lea, of Philadelphia.

23. What is the genus Litho'domus? (From the Greek, *lithos*, a stone and the Latin, *domus*, a house.)

24. How is the genus Anodo'nta recognised? (Anodo'nta. From the Greek, *a*, without, *odous*, in the genitive case, *odontos*, a tooth.)

25. What are the characters of the genus U'nio? (U'nio. Latin. A pearl.)

Fig. 101.—UNIO.

We also place in this same group certain marine mollusks, which resemble the unios, in their organization and the general disposition of the hinge, but in which the beaks (summits) of the shell are more arched, and from which projecting ribs radiate towards the circumference; such are the genus CARDITA, the form of which is more or less oblong or cordiform (heart-shape;) the CYPRICARDIA, in which the tooth beneath the summit of the shell is divided into two or three; the CORALLIOPHAGA, in which the shell is thin and the lateral plate much effaced &c.

26. In the FAMILY OF CHAMACEA, the mantle is closed and perforated by three openings only; through the anterior one passes the foot (*fig.* 102, *p.*) the next (*r*) gives passage to the water necessary for respiration, and the third (*e*), is for the expulsion of effete matters. As we have already stated, the two last openings are not prolonged into tubes, as in the two next families. And the hinge is very analogous to that of the unios; for the left valve has a tooth near the summit, and further back, a projecting plate, which are received into fossæ (pits) in the opposite valve.

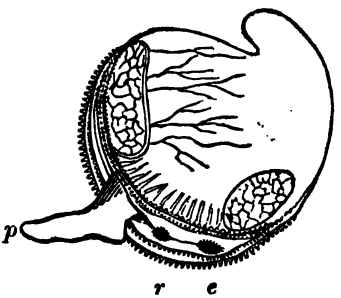


Fig. 102.—CHAMA, WITHOUT ITS SHELL.

Explanation of Fig. 102.—A Chama divested of its shell to show the disposition of its mantle:—*p.* the foot;—*r.* opening for respiration;—*e.* the opening for the passage of excrement.

26. What are the characters of the family of Chamacea?

This family is divided into Tridacna, Chama, Isocardia &c.

27. The TRIDACNÆ have an equivalve shell, which is elongate and gaping in front, or its edges are dentate (*fig.* 103). Their internal organization is remarkable in several particulars. The valves have only a single adductor muscle. The mantle is widely open in front, to give passage to the byssus, and a little beneath the anterior angle presents another opening, by which water is conveyed to the branchiæ; and the third opening, which corresponds to the anus, is situate near the middle of the inferior border. To this genus belongs an enormous shell of the Indian Ocean, known under the vulgar name of the holy-water pot; it adheres to the rocks by its byssus which is so large sometimes that an axe is required to cut it, and the shell itself occasionally weighs over three hundred pounds.

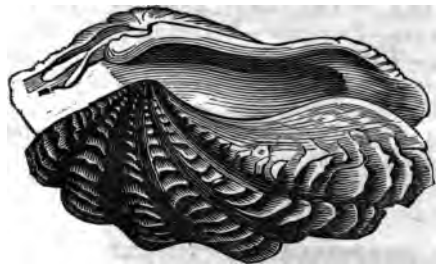


Fig. 103.—TRIDACNA.

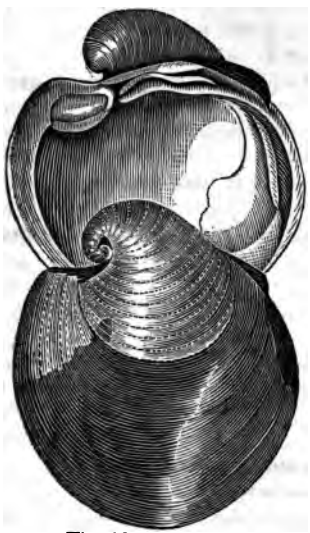


Fig. 104.—ISOCARDIA.

28. The CHAMÆ have an irregular, equivalve shell, which is usually lamellar and rough; they live attached to rocks, coral &c. like oysters, and they have a small foot bent like that of man, (*fig.* 102).

29. The ISOCARDIÆ (*fig.* 104), on the contrary have a free, regular, convex shell with spirally curved summits, divided anteriorly. A large smooth red species, the *Chama cor*, inhabits the Mediterranean.

27. What are the characters of the genus Trida'cna?

28. How is the genus Chama distinguished? (Chama,—pronounced *ka'ma*. From the Greek, *chaô*, I gape.)

29. What are the characters of the genus Isoca'rdia? (Isoca'rdia. From the Greek, *isos*, like, and *kardia*, a heart,—heart-shape.)

LESSON VI.

FAMILY OF CARDIACEA. — *Cardium* — *Donax* — *Cyclas* — *Corbis*—*Tellina*—*Venus*—*Petricola*—*Venerupis*—*Mactra.*
FAMILY OF INCLUSA.—*Lutraria*—*Mya*—*Byssomia*—*Hiatella* —*Solen* —*Sanguinolaria* — *Pholas* —*Teredo* — *Fistulana* — *Gastrochæna*—*Clavagella*—*Aspergillum.*
CLASS OF MOLLUSCA BRACHIOPODA.—*General Characters* —*Lingula*—*Terebratula*—*Orbicula.*
CLASS OF MOLLUSCA TUNICATA, or ACEPHALA NUDA.— *Biphora*—*Ascidia*—*Botryllus*—*Pyrosoma.*

CLASS OF ACEPHALA, CONTINUED.

1. The FAMILY OF CARDIACEA, is characterised by having the mantle open in front, and prolonged posteriorly into two tubes, which are sometimes distinct, and at others, united in a single mass; one of them (*fig.* 105, *r.*) serves for respiration, and the other, (*e,*) for the passage of excrement. This mode of conformation is recognised in the shell by the impression made by the attachment of the edge of the mantle, called the pallial line (*fig.* 106, *l.*) which, before joining the posterior muscular impression or cicatrix, (*mi*), curves more or less deeply inwards. In all these mollusks, there is a transverse muscle and a foot, (*fig.* 105, *p.*) which generally, enables the animal to crawl. The species that have long tubes, ordinarily live buried in the sand or mud.

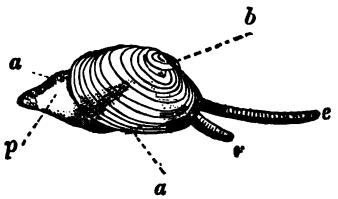


Fig. 105.—TELLINA.

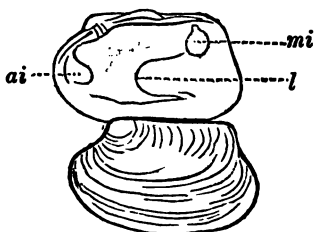


Fig. 106.—VENERUPIS.

Explanation of Fig. 105.—Tellina :—*a.* the shell;—*b.* the hinge;—*r.* tube for respiration;—*e.* tube for excrement;—*p.* the foot.

Explanation of Fig. 106.—Venerupis :—*l.* pallial line;—*ai.* anterior muscular impression;—*mi.* posterior muscular impression or cicatrix.

1. How is the family of Cardia'cea characterised? (Cardia'cea. From the Latin, *cardium*, heart.)

2. In this family, we place Cardium, Donax, Cyclas, Corbis, Tellina, Lucina, Venus, Petricola, Mactra, &c., genera, which, for the most part, are very numerous in species.

3. The CARDIA—*Cardium*—are chiefly characterised by the hinge which consists of two small teeth in each valve, situate in the centre, and a projecting plate or tooth placed at some distance in front, and behind. The shell is equivalve, convex, and furnished with ribs radiating from the summit towards the circumference. And when looked at from one side, its general form reminds us of that of a heart, from the manner in which the summits (beaks) of the valves rise up, and curve inwards towards each other.

4. The DONACES—*Donax*—have a hinge formed nearly like that of the Cardia; but their shell is flattened, nearly triangular, inequilateral and the summits are nearly vertical. Several small species are found on the coasts of France, the shells of which are very pretty.

5. The CYCLADES—*Cyclas*—have the same hinge and are distinguished from the preceding by the rounded form of the shell, which is equilateral, (that is, the two halves of the valve, situate on each side of a vertical line drawn through its summit, are alike), and striated transversely. One species *Tellina cornea*, is common on the coast of France. The genera *Cyrena* and *Cyprina* belong to this group.

6. The *Corbis* are transversely oblong marine shells, which resemble the preceding in the hinge; their external surface is very regularly marked by transverse ribs, crossed by diverging rays.

7. The TELLINÆ—(*fig.* 105) *Tellina*—closely resemble the donaces; but they have the middle of the hinge armed with one tooth to the left, and two to the right. The shell is slightly gaping. Like the donaces, they have two long tubes (*fig.* 105) which can be entirely concealed within the shell when the animal contracts. Both live buried in the sand and are found on the coast of France.

2. What are the principal genera belonging to the family of Cardiacea?

3. What are the characters of the genus Cardium?

4. What are the characters of the genus Donax?

5. How is the genus Cy'clas characterised? (Cy'clas. From the Greek, *kuklos*, a circle.)

6. What are the characters of the genus Corbis?

7. How is the genus Telli'na characterised?

8. The VENUS (*fig.* 107.) is recognised by the hinge, the anterior and posterior plates of which, instead of being separated from the middle tooth, as in the Cardia, &c, are approximated in a single group beneath the summit. The shell is generally thick, moderately convex, and a little elongated. The species of this genus are very numerous.

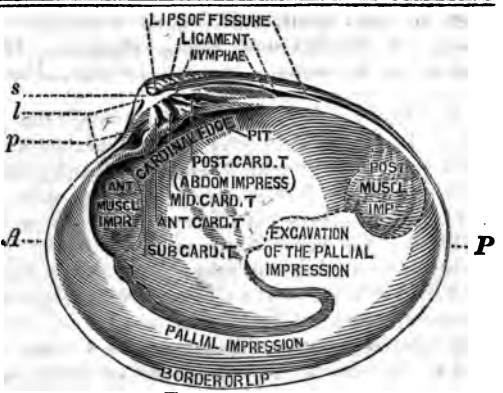


Fig. 107.—VENUS.

9. The genera Petricola and Venerupis, (*fig.* 106.) resemble the venus very much, and have obtained their names from living in the interior of stones which they perforate.

10. The MACTRÆ differ from other cardiaceæ in having an internal ligament, lodged in two pits in the hinge, corresponding with each other (*fig.* 108). There are some large species on our own coast.

Fig. 108.—MACTRA.

11. The fifth and last family of testaceous acephalæ or INCLUSA, is composed of mollusks in which the mantle is only open at its anterior extremity, or near the middle for the passage of the foot, and is prolonged posteriorly in a double tube; in other parts it is completely closed (*fig.* 109). The shell is always gaping at the extremities, and most of these animals live buried in the

Explanation of Fig. 107.—Cytherea or Venus:—*s.* the summit or beak; —*l.* the lunule;—*p.* pit;—*A.* anterior, and *P.* posterior extremity of the shell.

8. What are the characters of the genus Venus?

9. From what circumstance do the genera Petrico'la and Venerupis obtain their names? (Petrico'la. From the Latin, *petra*, a stone, and *colo*, I inhabit.—Venerupis. Latin. Venus and *rupes*, a rock)

10. How is the genus Ma'ctra characterised? (Ma'ctra. Latin. A trough.)

11. What are the general characters of the family of Inclusa? (Inclusa. Latin. Enclosed.)

sand or mud; sometimes they excavate holes in stones or wood. They are divided into Mya, Lutraria, Anatina, Glycymera, Solemya, Byssomia, Hyatella, Solen, Psammobia, Pholas, Teredo, Fistulana &c.

12. The LUTRARIÆ closely resemble the Mactræ; but their hinge is unprovided with lateral laminæ and their valves are very gaping, particularly behind, through which passes the thick fleshy cylinder formed by their double tube. A large species is found in the sand, at the mouths of several rivers in France.

13. In the Myæ there is a projecting plate in one of the valves and a pit in the other, joined by a ligament; the ANATINÆ have a small plate in each valve, giving attachment to a ligament; and the SOLEMYÆ and GLYCYMERÆ differ from the MYÆ in their external ligament.

14. The BYSSOMIÆ in place of living in the sand like the preceding, penetrate stones and corals, and attach themselves, to them by the aid of a byssus. Their shell is oblong, without a distinct tooth, and gaping about the middle of the inferior edge, for the passage of the foot.

15. The HYATELLÆ have nearly the same general form; but the tooth of the hinge is more marked.

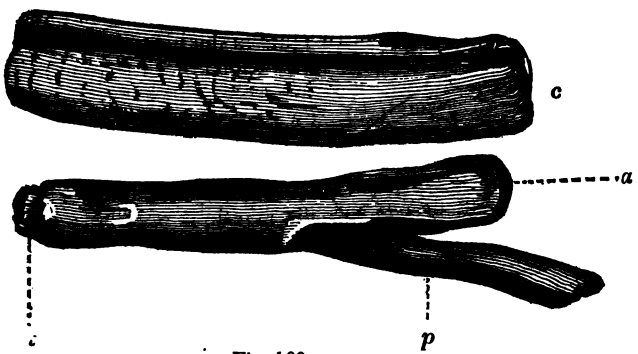


Fig. 109.—SOLEN.

16. The SOLENS, commonly called *razor shells, knife handles,* (*fig.* 109), from the cylindrical and elongated form of their shell, have the hinge furnished with an external ligament and

Explanation of Fig. 109.—*c.* the shell;—*a.* the anterior extremity of the mantle;—*p.* the foot;—*t.* the tentacles.

12. How is the genus Lutra'ria characterised?
13. What are the characters of the genus Mya?
14. What are the characters of the genus Bysso'mia?
15. How is the genus Hyate'lla characterised?
16. What are the characters of the genus Solen?

armed on each side, with two or three projecting and very decided teeth. Their foot is conical and is pushed out at the anterior extremity of the shell. They live in the sand, and bury themselves with great rapidity by the motions of their foot.

17. The PHOLADES are distinguishable from all the preceding by one or more calcareous pieces, situate between the two valves of the shell, near the hinge. The valves, which are broad and convex anteriorly, are elongated on the opposite side, and leave betwixt them a great oblique opening at each end; their hinge resembles that of the Myæ; their double tube is not retractile and may be very much elongated. These animals inhabit tubes or long cells which they excavate, either in the mud, or stones, or wood. There are large species on the coast of France, in the West Indies, and on the coast of Peru.

18. The TEREDINES, or *ship worms*, are celebrated for the ravages they commit by boring into ships' bottoms, piles of dikes, bridges, &c. These are mollusks with a very elongated and almost vermiform body, which is enveloped in a tubular mantle, open at the anterior and inferior part for the passage of the foot; it is provided posteriorly with two very short, distinct tubes, and its base is furnished on each side, with a moveable, stony plate; the shell is composed of two rhomboidal valves, but is very small, and covers only a very small portion of the mantle. It seems that the animal, by moving the extremity of its shell like an augur, excavates, in submerged wood, the hole which serves as its abode, and, as it advances or buries itself deeper, it lines the excavation with a calcareous matter, so that in a short time it finds itself lodged in a stony tube which at first might be mistaken for a second shell. It begins its attack upon wood when very young; hence the external opening of its gallery is very small, but it digs on until the termination of its growth, and progressively augments the size of its dwelling; the two tubes which occupy the posterior extremity of the mantle always remain near the opening of the gallery, and through one of them it causes the water necessary for respiration and nutrition to enter, for it

Fig. 110. TEREDO.

17. How is the genus Pholas characterised? (Pholas. From the Greek, *pholeos*, a lurking place.)

18. What are the characters of the genus Teredo? (Teredo. Latin. A ship-worm.)

always remains in its hole, with the mouth down and the anus above. The *common teredo*, which is about six inches long, it is said, was brought from the torrid zone, but it is widely spread in the seas of France, and infests the dikes of Holland to such an extent that its unperceived ravages have, more than once, been near producing terrible inundations. Vessels have been sunk by the holes bored through their bottoms by these animals. To guard against such accidents, is one among the reasons why ships bottoms are covered under water by thin sheets of copper.

19. The FISTULANÆ also live buried in sub-merged wood or other analogous substances, and also line the interior of their hole with a calcareous mortar which constitutes a tube, completely closed at the large end, having more or less resemblance to a bottle. Like the teridines, they have externally, a small bivalve shell, and two plates, which may be regarded as analogous to the opercular pieces of the gasteropods. They inhabit the Indian Seas.

20. The GASTROCHÆNÆ differ very little from the preceding; their shell, which is unprovided with teeth, is very gaping in front, and their double tube, which can be retracted entirely within the shell, is susceptible of great elongation; they excavate holes in stone or masses of madrepore, and often line these holes with calcareous matter which, on becoming hard, constitutes a tube similar to that formed by the teredo and fistulana.

21. We also place in this division, the CLAVIGELLA and ASPERGILLUM, which also construct a calcareous tube; in the first, one of the valves is clasped by the tube, while the other remains free in its interior; and in the last, the tube has at its closed extremity, a disk perforated by a great many little tube-like holes, an arrangement which has obtained for it the name of "watering-pot shell."

CLASS OF BRACHIOPOD MOLLUSKS.

22. These mollusks are very analogous to the common acephalæ; they are also provided with a two lobed mantle,

19. What are the characters of the genus Fistulana? (Fistulana. From the Latin, *fistula*, a pipe.)

20. What are the characters of the genus Gastrochæna? (Gastrochæna. From the Greek, *gaster*, belly, and *chainô*, I gape.)

21. What are the characters of Clavigella? (Clavigella. From the Latin, *clavis*, a nail, or spike.) How is the genus Aspergillum distinguished? (Aspergillum. Latin. A watering pot.)

22. What are the characters of Brachiopod Mollusks? (Brachiopod, pronounced *brak-e-opod*. From the Greek, *brachion*, a arm, and *pous*, foot.)

and a bivalve shell; they have no foot, but in place of it, two fleshy arms furnished with filaments, and susceptible of being unfolded externally, or drawn within the shell by folding spirally (*fig.* 111, *a.*); their branchiæ are not distinct from the mantle, and the mass formed by their viscera is very small. They are unprovided with organs of locomotion, and live attached to sub-marine bodies.

a

Fig. 111. TEREBRATULA.

The principal genera composing this group, are the Lingula, Terebratula, and Orbicula.

23. The LINGULÆ are provided with a long, fleshy peduncle, one extremity of which is generally attached to the rocks these animals ordinarily inhabit, and the other is furnished with two oblong, flattened valves. Their arms, which are inserted in the sides of the mouth, are very long; and the branchial vessels are distributed on the internal face of the mantle, and there form on each side a series of small parallel folds. They are found in the Asiatic Seas.

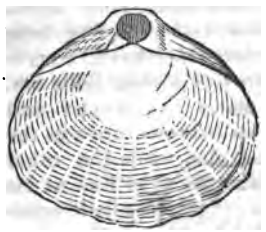


Fig. 112.—TEREBRATULA.

24. The TEREBRATULÆ have two unequal valves joined by a hinge, and one of them (*fig.* 112.) has a hole through its summit, for the passage of a fleshy peduncle, by means of which the animal attaches itself. Their branchiæ are less distinct than in the lingulæ, and consist simply of a vascular net work spread over the internal face of the mantle; but their muscular system is more developed, and there is found in the interior of the shell, a small solid frame, (*fig.* 113.) the structure of which is sometimes very complicated; its chief uses are to afford attachment to muscles, and to assist in separating the valves. Some living terebratulæ are found in the South Seas; but they abound most in the fossil state;

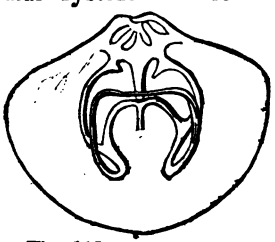


Fig. 113.—TEREBRATULA.

23. What are the characters of the genus Lin'gula? (Lin'gula. Latin. A latchet, or tongue of a shoe.)

24. What are the characters of the Terebra'tula? (Terebra'tula. From the Latin, *terebro*, I bore.)

and are found in the most ancient fossiliferous strata or layers of the earth's crust.

25. The ORBICULÆ have one round, conical valve like the shell of the patellæ, (*Fig.* 78, *p.*) while the other is flat and perforated for the passage of a very small peduncle; the conformation of their arms, and the arrangement of their branchial vessels, very closely resemble those of the terebratulæ.

CLASS OF MOLLUSCA TUNICATA, OR ACEPHALA WITHOUT SHELLS.

26. The acephalous mollusks without shells, which have also been called tunicata, differ much from all the preceding in their general form, as well as in many important particulars of their organization. Their mantle consists sometimes of a simple tube open at both ends, and sometimes of a sack; their branchiæ present different forms, but always very little developed, and are never divided into four leaflets or laminæ, as in the ordinary acephalæ, or lamellibranch testacea, among which they are placed by many authors; they have neither foot nor arm; and they evidently form the connecting link between the mollusks we have just described, and inferior animals which are ranged among the Polypi in the branch of Zoophytes.

27. The BIPHORÆ of all the tunicata possess the most complicated organization. Their mantle is tubular, furnished with transverse muscular bands, and enclosed in a transparent, car-

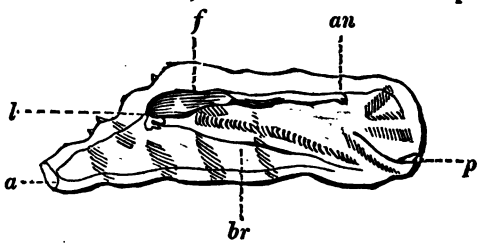


Fig. 114.—BIPHORA.

tilaginous envelope; both extremities are open, and the posterior orifice, (*p.*) is supplied with a little valve, so arranged as to admit the water, but not to allow its escape; the mouth

Explanation of Fig. 114.—*a.* the anterior opening of the mantle;—*b.* the mouth;—*f.* the liver, &c;—*an.* the anus;—*br.* the branchiæ;—*p.* posterior opening of the mantle.

25. What are the characters of the genus Orbicula?
26. What are the general characters of the class of Tunicata?
27. What are the characters of the genus Biphora?

is placed in the tube formed by the mantle towards its anterior extremity; and the heart, liver, and other viscera, are united into a small mass near this opening; the anus is situate far behind, and the only branchia, which is formed of a membrane transversely plaited, extends obliquely from the superior to the inferior parietes of the pallial cavity; the water which traverses this tube, consequently laves the respiratory apparatus, and the animal moves by forcibly expelling it from the side of the mouth: hence, we see it must necessarily swim backwards. When full grown, these mollusks are free; but at birth, they are frequently united to each other, forming a long chain, and swim in this manner for a long time; it seems that the individuals thus united, after becoming free or separated, produce young, which are not joined together in a chain as just described, and differ from them in form, and that the young arising from the last are united and similar to the first; so that in these singular animals there is the most remarkable alternation, the same form and the same mode of existence not being transmitted from one generation to the other, but constantly returning to the second generation.

The Biphoræ are found in the Mediterranean, and in the warmer regions of the ocean; they frequently emit a phosphoric light.

28. The simple ASCIDIÆ cannot move like the Biphoræ, but live attached to rocks; their mantle is in the form of a sack with two orifices, and the interior of this cavity is lined with a net-work composed of the branchial vessels; the mouth and the little bag or sack containing the viscera, are attached to the bottom of the great branchial cavity, and the anus is found near one of its openings.

29. Other tunicata, closely resembling the preceding in their organization, live united in a common mass, and for this reason they are designated under the name of ASCIDIA COMPOSITA or AGGREGATA. A gelatinous or cartilaginous tissue incloses a great number of these little beings, the surface of which presents a multitude of six-pointed stars formed by their openings; their propagation seems to be effected in two ways: sometimes the mass grows by the developement of reproductive buds in this common tissue, sometimes the young formed in an ovary are expelled externally, and swim about free or separately for some time, until they become attached to some sub-marine body, where they establish a new colony.

28. What are the characters of the genus Ascidia? (Ascidia. From the Greek, *askos*, a bottle or pouch.)

29. What is meant by the Aggregata? (Aggregata. Latin. Gathered together.)

30. We give the name of BOTRYLLUS to small aggregated tunicata of an oval form, which differ little from the preceding, except their branchial sack is open at both extremities, and the anal orifice terminates in a central cavity around which ten or twelve of these mollusks are grouped like the rays of a star.

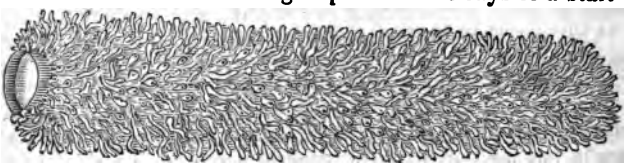


Fig. 115.—PYROSOMA.

31. The PYROSOMÆ unite in great numbers, forming a large hollow cylinder open at one end, and closed at the other, which swims in the ocean by the alternate contraction and dilatation of the animals that compose it. In their individual organization they are similar to the preceding.

OF THE PARTS OF SHELLS.

We have now brought our history of the Mollusca to a close; but with the view of imparting clearer notions on the subject of Conchology, or *History of Shells*, we shall add here a few words in relation to the parts of shells. It is absolutely necessary to understand these parts, before we can comprehend the descriptions given by Conchologists, or be able to describe shells in such a way as Conchologists can recognise them.

The most simple form of a shell is the cone, (*Fig.* 70, *page* 61.) The apex of the cone is oblique and excentric. In the limpets, (patella) argonaut, and nautilus, the apex is directed towards the head, but in most other mollusks, towards the opposite extremity of the body.

A shell may consist of one piece, as in the inopercular univalves—that is, univalves without an operculum or door.

A shell may consist of two pieces, as in the opercular univalves, (univalves with an operculum,) and in most bivalves.

A shell may consist of three pieces as in the *Terebratula*, (*Figs.* 112 *and* 113, *page* 93.)

A shell may consist of four or more pieces, as in some of the *Pholades*.

A shell may consist of many pieces, in which case it constitutes a multivalve, as the *Chiton*, (*Fig.* 79.)

30. What are the characters of the Botryllus? (Botryllus. From the Greek, *botrus*, a bunch of grapes.)

31. What are the characters of the genus Pyrosoma? (Pyrosoma. *From* the Greek, *pur*, fire, and *soma*, body—fire bodies; so called from *possessing the faculty* of emitting light.)

The univalve shells are much more numerous than any others, both in genera and species; and it requires a considerable degree of attention, to discriminate many of the *species*, as they run into each other so much.

In the examination of univalve shells, the general outline or contour of the whole shell, is the first particular to be attended to, as this leads to those distinctions necessary in the definition of simple, spiral, or turbinated shells, or more strictly, according to the Linnean method of discrimination, univalves with a regular spire, and those without a regular spire. Univalve shells are classified, principally from the shape of the aperture, taken in conjunction with the general shape of the shell; from the spire being lengthened or depressed, being with or without a canal, the length of the beak and its direction, together with the particular form of the outer or external lip: the colour of shells only serves as a *specific* distinction, and, even in this respect, cannot in all cases, be depended upon, although in others, it is an unvarying test. The particular manner in which the spots are disposed, frequently characterises species.

Apex, is the summit, tip, or highest part of a shell, (*fig.* 116.)

Base, is the opposite extremity from the apex, (*fig.* 116.) In shells with a *beak* or *rostrum*, (as the Murex, *fig.* 64.) it implies the tip of such beak; in shells without a beak, it is understood to be the lower part, as before mentioned, opposite the apex. In the patella, and some others, the base of the shell is that part on which it rests when it is laid on its mouth; in the Teredo, and similar shells, it is the wider end.

Body of the shell, is the first or lower whorl of the spire, in which the aperture is situated; this whorl is generally longer than the others, (*fig*, 18.)

Front of the shell, is that side where the aperture is situated.

Back of the shell is the opposite side to that in which the aperture is placed.

The *venter* or belly, is the most prominent part of the lower whorl or body, generally situated in the vicinity of the lip over the aperture, and formed by the convexity of the aperture. In general this term is only made use of in describing shells, whose body is large in proportion to the size of the spire, (*Figs.* 52 *and* 59.)

Sides of a shell, are the extreme edges of the shell, when viewed either in front or from the back. The right side is the one next the observer's left hand, when the shell is viewed in front; and the side with the aperture in it, is the left side.

The conical, univalve shell, is generally spirally convoluted; sometimes, as in the nautilus, (*Figs.* 15 *and* 16.) in the same

plane, but more usually in an oblique direction. As a general rule, the spiral univalve, if viewed in the position in which its inhabitant would carry it, if moving forwards from the observer, is twisted, from the apex downwards, from left to right, the spire being directed obliquely towards the right. The annexed figure, (*fig.* 116,) shows the involutions or whorls of the spire of the *Pleurotoma*. In some genera, for example, *Clausilia*, (from the Latin *clausus*, shut, *fig.* 25, *page* 44,) and *Physa*, (from the Greek, *phusa*, a bubble, *fig.* 30, *page* 46,) the shell is twisted in an opposite direction: such shells are called "perverse" or "sinistral."

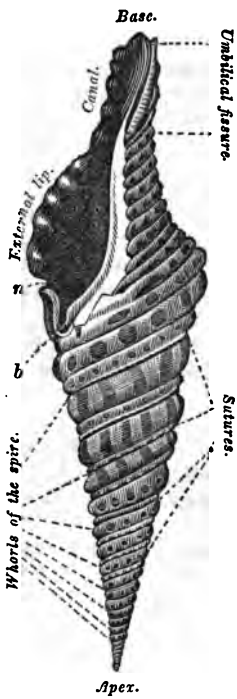


Fig. 116.—PLEUROTOMA.

The *aperture*, or mouth is that part of the lower whorl or body, through which the animal protrudes itself. This is one of the principal means of distinguishing the genera of univalve shells, and it varies much in its form; some apertures are rounded, (*fig.* 43, *and* 46.) others, semilunar, (*fig.* 55.) others, angular, (*fig.* 37,) &c. Some apertures have a canal at their base, (*fig.* 63, *and* 116.) and others are without it, (*fig.* 51.) In various genera, the aperture extends the whole length of the shell as in Ovula (*fig.* 68.), Cypræa, and some of the Cones with depressed spires, (*fig.* 70). In several individuals, the aperture is either entirely open, or closed by an operculum or door, which is usually affixed to the foot of the animal.

When without a notch or canal, the aperture is said to be entire, (*fig.* 51.) The aperture has two lips or borders; the *internal lip, or border*, is on the side of the aperture, formed by the columella, and the *external, or outer lip, or border*, is opposite, as in the *Pleurotoma*, (*fig.* 116.); the letter *b.* indicates the pallial notch; *n.* notch of the syphon.

Canal, or gutter, (*fig.* 116.) is the space or hollow, formed by the prolongation of the two lips of the aperture. Some shells have two canals, one situated at the point where the outer lip and body join.

Beak or *rostrum*, is that lengthened process in which the canal is situate. This process is not so conspicuous in some of the species of Voluta, but is more marked in the genera, Murex, Fusus, &c.

The *columella* or *pillar*, is that process which runs through the centre of the shell in the inside, from the base to the apex, and around which the whorls or wreaths of the spire are wound, (*Fig.* 19, *page* 38.) When the columella is marked by ridges, or folds, as in Auricula (*Fig.* 31.) and Oliva, (*Fig.* 67,) it is said to be plicated or plaited, but when it is smooth, as in (*Fig.* 116.) it is simple.

Pillar lip, is a continuation of the glossy process with which the aperture is lined, and expanded on the columella, (*Figs.* 58 *and* 66.) It is also called the inner or internal lip, (*Fig.* 116.)

The *outer lip*, or external border, is the expansion, or continuation of the body of the shell, on the left margin of the aperture, and is also lined with the glossy process of the aperture, (*Fig.* 116.)

Spire consists of all the whorls of the shell except the lower one, which, as before observed, is termed the body of the shell. This spire is a prominent feature of the univalve; and upon its being elevated, depressed, &c., depends much of the generic and specific definition of these shells.

It is a remarkable circumstance, that many of the young shells have not the same number of wreaths as the adults; from which it would appear, that the part of the animal nearest the apex, never increases in size. The number of wreaths cannot, at all times, be depended upon. A full-grown shell may, however, be known from the outer lip, which has generally an unfinished appearance in young shells. Indeed, in all the land and fresh water shells, it is a distinct criterion, as they are never complete in the form of the outer lip, till full-grown.

Whorl is one of the wreaths or volutions of the shell, (*Fig.* 116.)

Depressed spire is when the spire is very flat, as in the shells of the genus planorbis, (*Fig.* 29, *page* 46.)

Involuted spire, is where the spire is concealed in the inside of the first whorl or body, as in some of the Nautili, Cyprææ, Ovulæ, &c., (*Fig.* 68.)

Suture of the spire, or whorls, is a fine spiral line or seam, formed by the joining together of the whorls; it is sometimes crenulated, undulated, (waved,) or sulcated, (grooved,) and not unfrequently elevated or projecting, (*Fig.* 116.)

Reversed, or Heterostrophe Spire, is when the volutions of the spire revolve in the same manner as the common corkscrew, or

when the aperture is placed downwards, the nature of the spire runs upwards from the right hand to the left, (*Fig.* 25)

Chambers are the cavities, divided by partitions at regular, or irregular intervals, as in the Nautilus, (*Fig.* 15, *page* 34.)

Umbilicus is a circular perforation in the base of the lower whorl or body, (*See page* 38)

Sub-umbilicated shells, are those which have the umbilicus covered, in a greater or less degree, by a thin process; which, in some, almost entirely closes the aperture or mouth. This character is most commonly to be met with among species of Buccinum and Murex.

Umbilical Fissure, is a groove extending from the umbilicus, (*Fig.* 116.)

Shells which have no umbilicus are termed imperforate.

Siphunculus, (little syphon,) is that small, round, perforation which forms a communication between the chambers in the Nautilus, and penetrates through the whole spire of the shell, (*Figs.* 15 *and* 16.)

Varices are *transverse* ribs which cross the whorls of shells in some species of Buccinum, Murex, &c. Varices are formed by the periodical growth of the shells, these being the margin of the outer lip, to which the animal has attached its periodical enlargements, (*Fig.* 46.) In some species they have more the form of sutures than ribs; this is owing to the margin of the outer lip, being but slightly developed.

Ribs are those longitudinal and transverse protuberances which are, in many of the univalve shells, (*Fig.* 46.)

Teeth of univalves, according to Colonel Montagu, are not properly tooth-shaped protuberances, but are fine white laminæ or ridges, running spirally backwards, in a direction parallel to each other; those on the exterior lip may, in most instances, be traced through the outside of the shell, and are nearly alike in length, (*Figs.* 24, 25, *and* 42.)

Epidermis is a skin, or cuticle, covering the exterior surface of many shells, destined by nature to protect their surface from being injured.

True bivalve shells are peculiar to the Acephalous mollusca; and their presence is constant, although they are in a few instances too small to cover the whole body, and in the ship-borers (*teredo*) exist only as small instruments, limited to the function of excavating the burrows inhabited by these mollusks. But all the species, in which the bivalve shell is inadequate to the protection of the whole body, derive extrinsic defence by burrowing in sand, or stone, or wood; and they also commonly line their burrows with a layer of smooth and compact cal-

careous matter, forming a tube. This calcareous tube in some cases, is of considerable size and thickness. In the *clavagella* one valve, and in the *aspergillum* both valves, are soldered to this tube, which, in the latter, presents a peculiar modification of its exposed extremity, which resembles the end of the spout of a watering-pot. No two shells can present a greater contrast than do those of the *Placuna, and Aspergillum*; yet the organization of their respective constructors is essentially the same. In a classification of shells, the calcareous tubes of the *Dentalium, Serpula, Aspergillum, Vermetus* &c., would be associated in the same general group; but it needs only to observe how these products of animals, belonging not only to different classes, but to distinct primary divisions of the animal kingdom, are arranged in the cabinets of collectors, to be convinced that Conchology as a classificatory science, apart from Malacology (the science of mollusks), no longer exists.

With regard to the structure and physiological relations of bivalve shells, it may be observed, first, that in all acephalous mollusks which breathe by distinct lamellated gills (branchiæ), —*Lamellibranchiata*,—one valve corresponds to the left, the other to the right side of the animal; but in the Brachiopodous bivalves, one valve is applied to the ventral, and the other to the dorsal aspect of the animal.

In all the lamellibranch bivalves which are free, the two valves are symmetrical, and the shell is termed *equivalve;* in all those which adhere by one of their valves to foreign bodies, this valve is deeper and larger than the unattached valve; such shells are termed *inequivalve*. Of those acephalans which are attached to foreign bodies by means of a byssus, some, as the *Tridacna*, (*fig.* 103.) are equivalve, and both valves are notched, to form the hole for the passage of the byssus; while others, as the *Pecten*, (*fig.* 91,) and *Avicula*, (*fig.* 95,) are inequivalve, the byssus passing through a groove in the right valve.

If the shell of the common cockle be examined, each valve will be seen to be produced into a conical prominence bent towards, and nearly meeting, at that part by which the valves are joined together. These prominences are termed the *umbones*, or sometimes *beaks*. The apex of the *umbo* corresponds to the apex of the univalve shell, and is the point at which the developement of the bivalve commences. When the apex is directed in the transverse plane of the shell, and so placed, that a division of the shell in that plane through the apices shall divide the valve into two *equal* parts, the shell is termed *equilateral;* of this form the Pecten (*fig.* 91,) is an

example. When upon a similar division, a slight difference is observed in the two valves, the shell is termed *sub-equilateral;* but where the difference is well marked, it is an *inequilateral bivalve,* (*fig.* 117.) When the apex is bent, as is commonly the case, out of the transverse plane, it is always directed more or less towards the anterior part of the shell; if such a bivalve shell as the *Cytherea,* or *Isocardia,* be held before the observer, with umbones directed forward, and the hinge above,—in the position in fact, in which the living animal would place itself if it were creeping forwards from the observer,—the right valve will of course correspond with the right hand of the observer, and the left with the left.

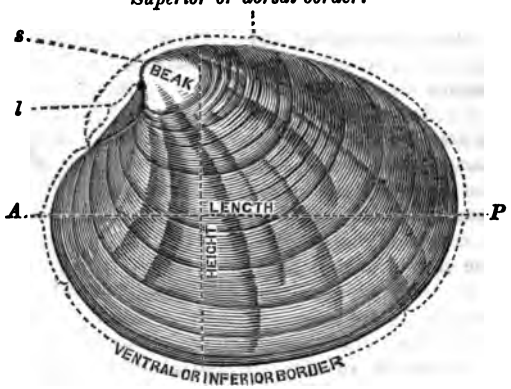


Fig. 117.—LEFT VALVE OF A CYTHEREA.

The annexed figure, (117,) represents the left valve of a *Cytherea,*—the common clam belongs to this group, and would answer our purpose as well, You see that the superior or dorsal margin is on the side where the hinge is placed, and the ventral or inferior border opposite to it; *A,* is the anterior margin or slope; *P,* the posterior margin or slope; the *umbo* is marked "BEAK," and *s,* points to the summit or apex of the beak; *l,* shows the situation of the *lunule.* Now, if a bivalve in which the apices have a spiral twist, as in the *Isocardia,* (*fig.* 104,) be placed in the above position, and compared with the univalve shell of the *Purpura,* it will be seen that the *left* valve corresponds with the ordinary or dextral spiral univalve, and the *right* valve to the perverse or sinistral univalve.

When the circumference or margin of one valve fits exactly at every part, that of its fellow, it is said to be "regular" or "*entire;*" but if it be notched at any part, so as not to come

in contact with the corresponding part of the opposite valve, it is "irregular," or *emarginate.*

Besides the parts mentioned, we shall find in most cases, anterior to the apices of the beaks, a depression of variable extent and depth. This is the *lunule,* (*fig.* 118, *l.*): it may be cordiform, or crescentic, lanceolate, (oblong and gradually tapering towards each extremity,) oval, deep, superficial, &c. Behind the beaks is another depression, longer and narrower than the lunule, and which is called the *Fissure,* (*f.*), and its margins are named lips of the fissure, (*lf.*) Behind the fissure there is sometimes a small depression called the suture, (*s.*) The general more or less convex surface of each valve is called the "venter," or belly, which terminates in the *limb,* circumference or margin. In the figure (118), the letters designate parts, as follows: *A,* anterior slope; *P,* posterior slope; *L,* left valve; *R,* right valve: *l,* lunule; *f.* fissure; *lf,* lips of the fissure; *s,* suture; *lig,* ligament; *ny,* the nymphæ.

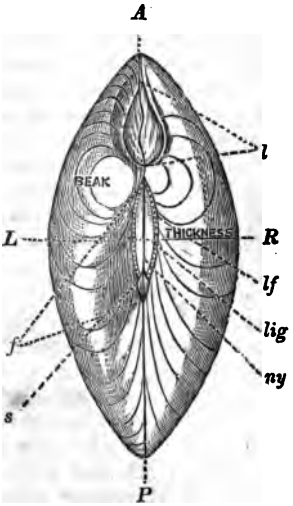


Fig. 118.—CYTHEREA.

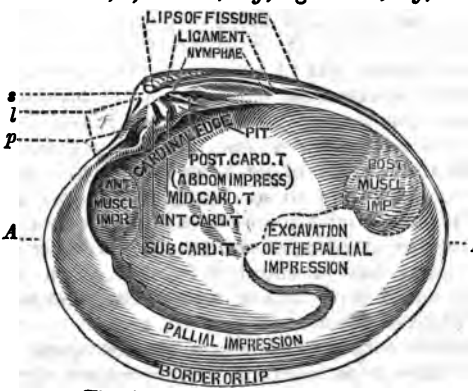


Fig. 119.—RIGHT VALVE OF A CYTHEREA.

The most important part of the margin is that which is modified to form the joint or hinge upon which the two valves

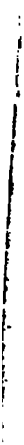
open and shut. This part is called the "cardinal edge," (*Fig.* 119,) and generally presents certain prominences and depressions; the projections of one valve interlocking with the depressions of the other. The projections, or "teeth," together with the cavities or "cardinal pits" (*p.*) are very regular in their formation in each genus and species of bivalve, but what is of more importance, is, that every modification in the structure of the hinge is generally found to coincide with some recognizable and more or less important difference in the organization of the soft parts; so that Conchologists have justly attached great value to the characters derivable from the hinge, especially for the purpose of generic distinctions. When the teeth are situate beneath the apex (*s*,) or centre of the hinge, they are called *cardinal* or *primary;* when they are removed from the centre of the hinge, they are named *lateral* teeth; when two only are present, one is called anterior, the other posterior; when there are three, they are distinguished respectively as anterior, median or middle, and posterior teeth; but when the hinge is composed of a great number of teeth, it is said to be "serial," as in *Arca*, (*Fig.* 97,) some hinges have no visible teeth, and are termed *inarticulate.*

The direct medium of union of the two valves is a dense fasciculus (bundle) of elastic fibres, generally of a brown colour, called *ligament* or *elastic ligament.* The fibres of this part are attached, by their extremities, to the two valves which in most cases, present a particular depression for their reception. The ligament is always so long, as to prevent the actual closing of the valves, except when its elasticity is overcome by a certain force, as by that of the contraction of the adductor muscle or muscles: thus, the inorganic power of elasticity is made the direct antagonist of a vital and muscular contraction; and as the open or expanded condition of the bivalve shell is that which the exigences of the animal most constantly require, it is assigned to a force which can act without ever causing fatigue, while the occasional or protective action of forcibly closing the valves, is due to an action under the immediate control of the will or instinctive sensation. The modifications of the internal surface of a bivalve shell, are caused by the structure of the animal inhabiting it: hence, they afford the characters by which the habits of an extinct genus may be to a great extent determined.

These modifications are marked on the last figure.

The *pallial impression* shows the developement of the muscular margin of the mantle.

THE END.



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